PB-229 293

PROCEEDINGS. CONFERENCE IN THE MATTER OF POLLUTION OF LAKE ERIE AND ITS TRIBUTARIES HELD AT CLEVELAND, OHIO ON 3-6 AUGUST 1965

Public Health Service
Washington, D.C.

August 1965

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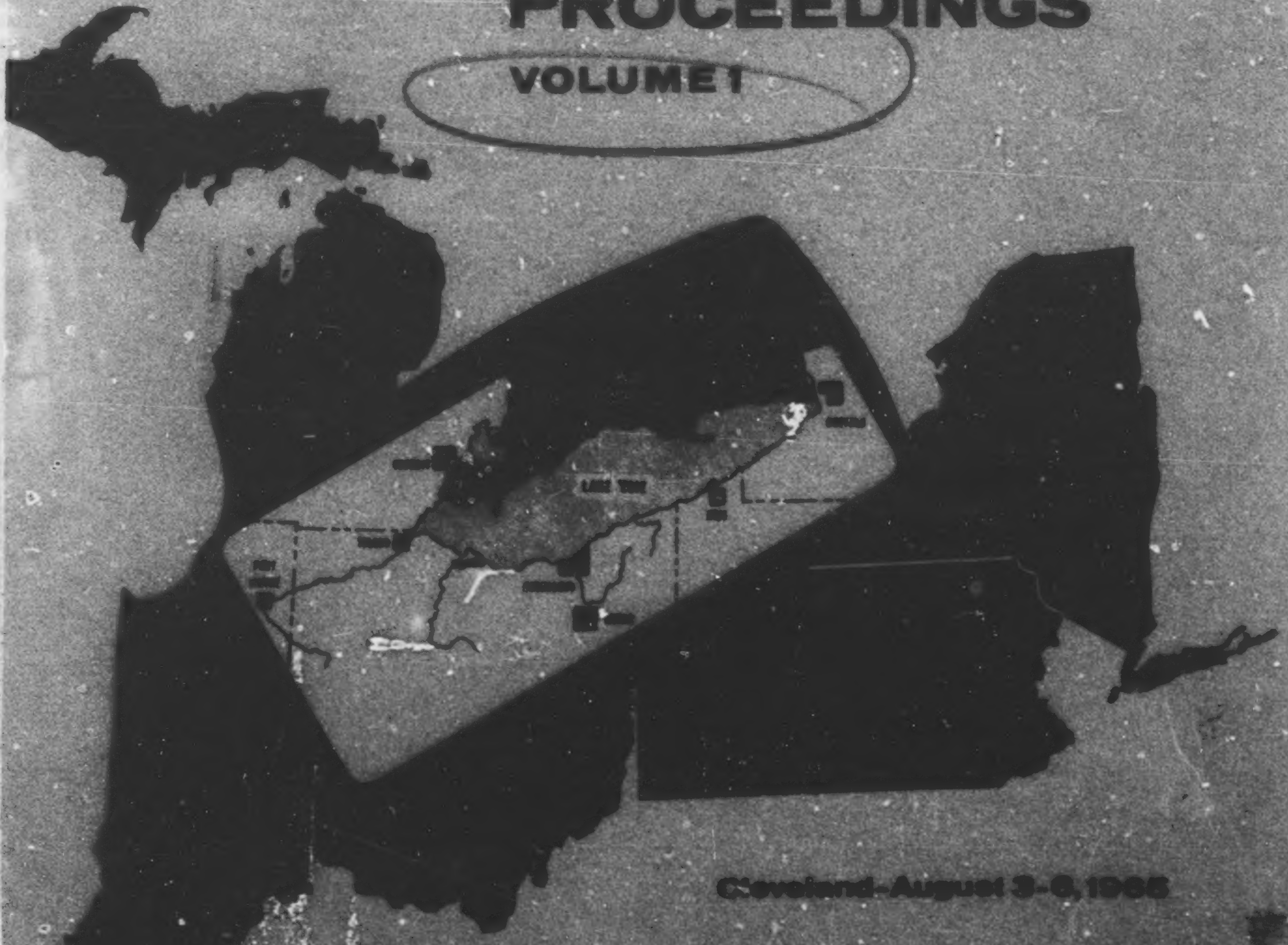
PROCEEDINGS

VOLUME 1



Cleveland-August 3-6, 1965

Conference

In the matter of Pollution of Lake Erie and its Tributaries

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Conference in the Matter of Pollution of the Interstate and Ohio Intrastate Waters of Lake Erie and its Tributaries, convened at 9:30 a.m., Tuesday, August 3, 1965, at the Sheraton Cleveland Hotel, Cleveland, Ohio.

PRESIDING:

Mr. Murray Stein, Chief, Enforcement Branch, Water Supply and Pollution Control, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C.

CONFEREES:

George H. Eagle, Chief Engineer, Ohio Department of Health, Columbus, Ohio

Dr. E. W. Arnold, Director of Health, Ohio Department of Health, and Chairman of the Water Pollution Control Board, State of Ohio

Fred E. Morr, Director of Natural Resources, State of Ohio

Robert D. Hennigan, Bureau of Water Resource Services, New York State Department of Health

CONFEREES (Continued):

Richard Boardman, Chief, Stream Quality Section, Pennsylvania Department of Health

Blucher A. Poole, Technical Secretary, Indiana Stream Pollution Control Board, Indianapolis, Indiana

H. W. Poston, United States Department of Health, Education, and Welfare, Chicago, Illinois

Loring F. Oeming, Executive Secretary, Michigan Water Resources Commission

PARTICIPANTS:

A. V. Agnew, Superintendent, Water and Sewer Department, Lorain, Ohio

Harry L. Allen, Vice President, Republic Steel Corporation, Cleveland, Ohio

David Blaushild, Cleveland, Ohio

Charles R. Collier, Assistant District Chief, U. S. Geological Survey, Columbus, Ohio 43209

Grover W. Cook, United States Department of Health, Education, and Welfare, Chicago, Illinois

PARTICIPANTS (Continued):

James B. Coulter, United States Department of Health, Education, and Welfare, Washington, D.C.

Vincent M. DeMelto, Director of Public Utilities, City of Cleveland, Cleveland, Ohio

Honorable John D. Dingell, Member of Congress from the 16th Congressional District, House of Representatives, Washington, D. C.

Herbert J. Dunsmore, Engineer, United States Steel Corporation, Pittsburgh 19, Pennsylvania

Robert E. Fahey, Director of Public Service, City of Akron, Akron, Ohio

Harold F. Elkin, Coordinator of Pollution Abatement, Sun Oil Company, Philadelphia 3, Pennsylvania

John J. Garner, Lake County Sanitary Engineer, Painesville, Ohio

Walter E. Gerdel, Commissioner, Division of Water Pollution Control, Cleveland, Ohio

Leonard J. Goodsell, Executive Director, Great Lakes Commission, Ann Arbor, Michigan

Gerald Goshorn, Superintendent, Village of Flat Rock Water Supply and Distribution, Flat Rock, Michigan

PARTICIPANTS (Continued):

George L. Harlow, Director, Detroit River-Lake Erie Project, United States Department of Health, Education, and Welfare, Grosse Ile, Michigan

Frank F. Hooper, Chief Biologist, Institute of Fisheries Research, Michigan Department of Conservation, Ann Arbor, Michigan

Stephen A. Kaufman, Deputy Director, Regional Planning Commission, Cleveland, Ohio

K. L. Kollar, Director of the Water Industries and Engineering Services Division, BDSA, United States Department of Commerce, Washington, D. C.

Honorable Ralph S. Locher, Mayor, Cleveland, Ohio

Verne L. Harris, League of Ohio Sportsmen and National Wildlife Federation

Charles W. Lounsbury, Plant Manager, E. I. duPont deNemours and Company, Inc., Cleveland, Ohio

Olga M. Madar, UAW-CIO Recreation Department, Detroit, Michigan

Stephen Megregian, United States Department of Health, Education, and Welfare, Chicago, Illinois

Perry Miller, Assistant Director, Division of Sanitary Engineering, Indiana State Board of Health, Indianapolis, Indiana

PARTICIPANTS (Continued):

Mrs. Howard T. Moore, Director, League of Women Voters of Ohio, Chardon, Ohio

Colonel R. Wilson Neff, District Engineer, United States Army Corps of Engineers, Buffalo, New York

Harriet Roth Parsons, Willoughby, Ohio

Honorable John Pilch, Councilman, City of Cleveland, Cleveland, Ohio

Paul R. Pine, Vice President, The Harshaw Chemical Company, Cleveland, Ohio

Ernest D. Premetz, Deputy Regional Director, Bureau of Commercial Fisheries, United States Department of the Interior, Ann Arbor, Michigan

Ralph W. Purdy, Chief Engineer, Michigan Water Resources Commission, Lansing, Michigan

Honorable James A. Rhodes, Governor of Ohio, Columbus, Ohio

Honorable Anthony J. Russo, State Representative, Columbus, Ohio

R. N. Simonsen, Consultant, Air and Stream Pollution, Standard Oil Company, Cleveland, Ohio

Reverend Andrew W. Smith, Pastor, Fridens United Church of Christ, Cleveland, Ohio

PARTICIPANTS (Continued):

Arvo E. Sundberg, Chairman, Conneaut Port Authority, Conneaut, Ohio

John W. Talbert, Jr., First Vice President, Ohio Division of Izaak Walton League of America, E. Cleveland, Ohio

Clarence M. Tarzwell, United States Department of Health, Education, and Welfare, Wakefield, Rhode Island

Honorable Charles A. Vanik, Member of Congress from the 21st Congressional District of the State of Ohio, House of Representatives, Washington, D. C.

Fred Wampler, Regional Coordinator, Ohio River-Appalachian Area, United States Department of the Interior, Cincinnati, Ohio

George H. Watkins, Executive Director, Lake Erie Watershed Conservation Foundation, Cleveland, Ohio 44114

Henry Sinkiewicz, Councilman, Chairman City of Cleveland Council Committee on Air and Water Pollution

PARTICIPANTS (Continued):

R. M. Whitt, Superintendent, Sherwin-Williams Company, Cleveland, Ohio 44101

Donald J. Yark, Director, Department of Public Utilities, City of Toledo, Toledo, Ohio

OTHERS IN ATTENDANCE:

Jonathan F. Abel, President, Cleveland Film Center, Cleveland 03, Ohio

Mrs. T. M. Adams, Water Resources Chairman, League of Women Voters of Willoughby, Willoughby Hills, Ohio

Tom Allen, Northwestern University Student, Rocky River 16, Ohio

Earl J. Anderson, Regional Program Director, Water Supply and Pollution Control, Department of Health, Education, and Welfare, New York, New York

Robert H. Anderson, Project Manager, Stanley Engineering Company, Cleveland 15, Ohio

Mrs. James H. Angel, Chairman, Citizens for Land and Water Use, Lakewood, Ohio 44107

J. L. Appleton, Bechtel Corporation, San Francisco, California

Robert A. Arnoldi, United Aircraft Corporation (Research Laboratories) East Hartford, Connecticut

B. R. Atkinson, Republic Steel, Cleveland, Ohio

L. P. Aurbach, President, Industrial Publishing Company, Cleveland, Ohio

Bill Baker, Newsman, WERE, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued):

Hiram Bakes, Project Engineer, Parsons-Brinckerhoff, Quade and Douglas, New York City, Kent, Ohio

Naomi Banks, Water Chairman, League of Women Voters, Cleveland, Ohio 44120

Mrs. Gershom M. Barber, League of Women Voters, Bay Village, Ohio

John O. Barrett, Superintendent, Westerly Water Pollution Control Plant, City of Cleveland, Cleveland, Ohio 44130

Clarence P. Baugher, Superintendent, Sewage Treatment Plant, Conneaut, Ohio

Paul Allen Beck, Intern, Greater Cleveland Ass. Foundation, Cleveland, Ohio

Mrs. Richard T. Becker, President, League of Women Voters of Cuyahoga Falls, Ohio, Cuyahoga Falls, Ohio

Roger S. Benjamin, Chemist, Rand Development Corporation, Cleveland, Ohio

Jack Bergren, J. P. Bergren Company, Cleveland, Ohio 44118

Joseph G. Berick, Attorney, Cleveland 14, Ohio

R. J. Bernhagen, State Geologist, Ohio Division Geological Survey, Columbus, Ohio

OTHERS IN ATTENDANCE (Continued):

R. G. Beverly, Chairman, Pollution Control Committee, Union Carbide Corporation, Mining and Metals Division, Grand Junction, Colorado

Miss Mildred K. Bickel, Member, Pollution Committee, League of Women Voters, Euclid, Ohio 44123

Suzanne Biddle, League of Women Voters, Euclid, Ohio

D. John Biechele, President and Owner, East Bay Fur and Fish Farm, Sandusky, Ohio

R. G. Bierbaum, Head Equipment Engineer 'A', NASA, Cleveland, Ohio

K. E. Biglane, United States Department of Health, Education, and Welfare, Washington, D. C.

A. M. Billings, Cleveland, Ohio 44114

Hayse H. Black, Industrial Waste Consultant, United States Public Health Service, Cincinnati, Ohio 45226

George L. Blaha, Councilman, Ward 33, Cleveland, Ohio

Mrs. H. E. Boehm, Water Chairman, League of Women Voters, Cleveland, Ohio 44121

Harold A. Bolz, Dean of Engineering, Ohio State University, Columbus, Ohio 43210

OTHERS IN ATTENDANCE (Continued):

Mr. Lee Borton, Lucas County Soil Conservation, Maumee, Ohio

Duane A. Bosworth, Soil Conservationist, Cleveland, Ohio 44136

Peter S. Bradley, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh, Pennsylvania

Larry G. Brake, Assistant Attorney General, Columbus, Ohio

E. C. Brennan, CEI

S. D. Bresler, Director of Utilities, City of Lima, Lima, Ohio

R. H. Bridges, Manager of Public Information, The Illuminating Company, Cleveland, Ohio

George R. Brisben, Rocky Rurr, Ohio

Ray Broggini, Public Health Service, Parma Heights, Ohio

Jack F. Brown, Mill Manager, Owens-Illinois, Jaite, Ohio

Lloyd A. Brown, Vice President, Propeller Club of Toledo, Toledo, Ohio

Robert P. Brown, Council President, City of Eastlake, Eastlake, Ohio

Mrs. R. W. Brownfield, Rocky River, Ohio

OTHERS IN ATTENDANCE (Continued):

J. R. Bruch, Manager, Area Development Department, The Illuminating Company, Cleveland, Ohio

Raymond A. Buner, Science Editor, The Blade, Toledo, Ohio

James W. Bryant, District Engineer, Roots-Connersville Division, Dresser Industries, Inc., Cleveland, Ohio

John C. Bumstead, Consulting Engineer, Cleveland, Ohio 44112

Harold N. Burke, Meteorologist, United States Weather Bureau, Cleveland, Ohio 44135

Robert Burn, Sanitary Engineer, Detroit River-Lake Erie Project, United States Public Health Service, Grosse Ile, Michigan

Ashworth Burselm, Manager, Public Relations, Hercules Powder Company, Wilmington, Delaware

E. L. Bussey, Director, Community Relations, Pennsylvania Electric Company, Johnstown, Pennsylvania 15907

Frank A. Butrico, Director, Environmental Health Sciences Programs, Battelle Memorial Institute, Washington, D. C. 20036

W. R. Cady, Technical Assistant, Solvay Process, Detroit, Michigan

OTHERS IN ATTENDANCE (Continued):

George S. Caldes, E. I. du Pont de Nemours and Company, Wilmington, Delaware

D. L. Calhoun, Works Engineer, Jones and Laughlin Steel Corporation, Cleveland, Ohio

John R. Calhoun, Quality Manager, IRC Fiber Division, Midland-Ross, Painesville, Ohio

Charles B. Camp, Wall Street Journal, Cleveland, Ohio

Donald C. Campbell, Sup. Recreation Resource Spec., Bureau of Outdoor Recreation, Ann Arbor, Michigan

Mrs. Irene F. Carson, Hudson League of Women Voters, Water Committee, Hudson, Ohio

Mrs. E. Carter, League of Women Voters, Cleveland, Ohio

John Carver, Canton, Ohio

Donald J. Casey, Oceanographer, United States Public Health Service, Rochester, New York

Victor L. Casper, Aquatic Biologist, United States Public Health Service, Cleveland, Ohio

Mrs. M. Chancey, League of Women Voters, Water Committee, Cleveland, Ohio 44118

OTHERS IN ATTENDANCE (Continued):

Mrs. Alan Childs, League of Women Voters of Rocky River, Rocky River, Ohio

Mrs. Margaret Cichanowicz, League of Women Voters, Galion, Ohio 44833

Joseph R. Clark, Associate, Parsons, Brinckerhoff, Quade and Douglas, New York, New York

Thomas Colpetzer, Assistant County Sanitary Engineer, Painesville, Ohio

Joseph W. Conn, North Olmsted, Ohio

W. J. Conner, Attorney, E. I. du Pont de Nemours and Company, Wilmington, Delaware

T. M. Connolly, Engineer, Union Carbide Corporation, Ashtabula, Ohio

E. S. Connor, Eastlake, Ohio

Grover W. Cook, Chief, Enforcement, Public Health Service, Chicago, Illinois

Ralph Copp, Assistant Director, Ohio Department of Agriculture, Columbus, Ohio

Mrs. Carl E. Corgder, Water Committee, League of Women Voters, Cleveland, Ohio

L. Bennett Coy, Secretary-Treasurer, Miami Conservancy District, Dayton, Ohio

OTHERS IN ATTENDANCE (Continued):

Mrs. Jean T. Craig, State Chairman, Nature and Conservation, Ohio Association of Garden Clubs, Washington, Ohio 43160

L. C. Crawford, Hydraulic Engineer, Miami Conservancy District, Dayton, Ohio

Mrs. William H. Crawford, Jr., League of Women Voters, Euclid 32, Ohio

Charles A. Crown, Administrative Director, City of Euclid, Euclid, Ohio

Mrs. Robert L. Cummings, Secretary to Lake Erie Basin Study Committee of League of Women Voters, Wickliffe, Ohio 44092

H. G. Curtis, Health Commissioner, Cuyahoga County, Cleveland, Ohio 44113

Charles A. Dambach, Director, Natural Resources Institute, Ohio State University, Columbus, Ohio

Fortunato Damiano, President, Maple Heights Homeowners Association, Maple Heights, Ohio

Nicholas T. Daramus, Administrative Assistant, Cuyahoga County Sanitary Engineer, Cleveland, Ohio

Harry A. Dawsey, Engineer, Reactive Metals, Inc., Ashtabula, Ohio

Marguerite V. Day, Parma, Ohio

OTHERS IN ATTENDANCE (Continued):

David DeLuca, City Manager, Ashtabula, Ohio

Vincent M. DeMelto, Director, Public Utilities, Cleveland 14, Ohio

A. E. Dewey, Director, Ohio Petroleum Council, Columbus, Ohio 43215

Mrs. G. R. DiCuccio, League of Women Voters, Euclid 23, Ohio

Thomas Dicksie, Public Health Service, Cleveland, Ohio

Honorable John D. Dingell (read by Peter Kuh), Congressman, 16th District, Michigan, House of Representatives, Washington, D. C.

Jack C. Donovan, Executive Director, Lake County Planning Commission, Painesville, Ohio

Mrs. Robert T. Dorsey, Civic Development Chairman, Garden Club of Ohio, Shaker Heights, Ohio

R. J. Dougherty, Chief Sanitary Engineer, Rockoff, Associates, Cleveland, Ohio

Franklin Drab, Euclid, Ohio

F. T. DuBine, Manager, Services and Utilities, Campbell Soup Company, Napoleon, Ohio

Herbert J. Dunsmore, Engineer, United States Steel, Pittsburgh 19, Pennsylvania

OTHERS IN ATTENDANCE (Continued):

Sidney Edelman, Chief, Environmental Healtn Branch, Public Health Division, Office of General Counsel, Department of Health, Education, and Welfare, Washington, D. C.

Nelson J. Ehlers, Assistant to Vice President and General Manager, Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania

Mrs. D. E. Ehlinfelat, Garden Club of Ohio

E. V. Ehrbar, Project Engineer, Lubrizol Corporation, Wickliffe, Ohio

Henning Eklund, Chief, Enforcement Section, Public Health Service, Department of Health, Education, and Welare, Chicago, Illinois 60607

Harold F. Elkin, Coordinator of Pollution Abatement, Sun Oil Company, Philadelphia 3, Pennsylvania

Clarence E. Enerick, Laboratory Technician, Lorain Water Treatment, Lorain, Ohio

Seba H. Estill, Izaak Walton League, Cleveland Heights, Ohio

Elizabeth V. Evans, Chairman, Water Committee, League of Women Voters of Gauge County, Chesterland, Ohio

John C. Everett, Chief, Plant Services Division, NASA, Lewis, Cleveland 35, Ohio

OTHERS IN ATTENDANCE (Continued):

Lloyd L. Falk, E. I. duPont deNemours and Company, Wilmington, Delaware

Marvin B. Fast, Program Operations Officer, United States Public Health Service, Ann Arbor, Michigan

Walter A. Fielding, Engineer, City of Akron, Ohio, Bureau of Engineers, Akron, Ohio

Harry Fitzgerald, Esq., Route No. 1, Mentor, Ohio

George Flick, West Side Civic Council, Cleveland, Ohio

George E. Flower, Former City Commissioner, Cleveland, Cleveland, Ohio

W. R. Forsyth, Plant Superintendent, Ohio Edison Company, Akron, Ohio 44313

William Foster, Senior General Attorney, United States Steel, Pittsburgh, Pennsylvania

Mrs. Donald T. Francis, League of Women Voters, Cleveland Heights, Ohio 44106

A. J. von Frank, Allied Chemical Corporation, Elkins Park 17, Pennsylvania

James E. Frook, Commissioner of Sewage Disposal, Toledo, Ohio 43611

OTHERS IN ATTENDANCE (Continued):

S. L. Frost, Executive Secretary, Ohio Water Commission, Columbus, Ohio

John C. Funk, Superintendent, Water Pollution, Ashtabula, Ohio

Clara Ganzenmueller, Chairman, Community Relations, The College Club of Cleveland, Cleveland, Ohio 44106

Mrs. David Garland, League President, League of Women Voters of Euclid, Euclid, Ohio 44123

John J. Garner, Lake County Sanitary Engineer, Painesville, Ohio

Anthony J. Garotali, Councilman, Ward 19, City of Cleveland, Cleveland 20, Ohio

Mrs. M. Garr, Shaker Heights, Ohio

George Garrett, Assistant Engineer, Ohio Department of Health, Columbus, Ohio

Mrs. Ira E. Garver, Treasurer, League of Women Voters, Cuyahoga Falls, Ohio 44223

Edward V. Geismar, Chief Enforcement Officer, United States Public Health Service, New York, New York

Edwin E. Geldreich, Microbiologist, Taft Center, Cincinnati, Ohio 45230

OTHERS IN ATTENDANCE (Continued):

Walter E. Gerdel, Commissioner, Division of Water Pollution Control, Cleveland, Ohio

T. B. Gibson, Stauffer Chemical Company, New York, New York

Mrs. Ralph Giffen, League of Women Voters of Ohio, Wooster, Ohio

Richard W. Gimbert, Ohio Department of Health, Columbus, Ohio 43215

Allan Gipson, Public Health Service, Cleveland, Ohio

Alphonse J. Glinka, Vermilion, Ohio

Daneen E. Good, Euclid League of Women Voters, Euclid, Ohio

Joseph Goodman, Cleveland 14, Ohio

Colonel L. J. Goodsell, Executive Director, Great Lakes Commission, Ann Arbor, Michigan

J. A. Gouch, Superintendent, Effluence, Allied Chemical, Buffalo, New York

Mrs. A. G. Graber, League of Women Voters of Lakewood, Lakewood, Ohio 44107

M. E. Graham, Vice-President, Hammermill Paper Company, Erie, Pennsylvania

Miss Joanne Grecar, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued):

Mrs. Winford W. Greiling, Director, League of Women Voters, Cleveland, Ohio 44117

Winford W. Greiling, Mechanical Engineer, Cleveland, Ohio 44117

Alan Gressel, Plant Manager, Research Oil Refining Company, Cleveland, Ohio

Mrs. B. I. Griffith, Columbus, Ohio

Ben J. Gryctko, United States Department of Health, Education, and Welfare, Washington, D. C.

Dorothy L. Gurley, Cleveland, Ohio

Edward Haddad, President, Joe Haddad and Sons Const. Co., Parma, Ohio

G. A. Hall, Engineer-Secretary, Ohio Water Pollution Control Board, Columbus, Ohio

Richard D. Hall, Cleveland, Ohio

Mrs. Josephine Hallock, Cleveland, Ohio 44121

George P. Hanna, Jr., Director, Water Resources Center, The Ohio State University, Columbus, Ohio 43210

Mrs. J. Louis Hanna, Water Resources Study Chairman, League of Women Voters of Euclid, Ohio, Euclid, Ohio 44123

OTHERS IN ATTENDANCE (Continued):

James Hanson, Counsel, Ohio Department of Natural Resources, Columbus, Ohio

John C. Harbert, Counsel, Sun Oil Company, Philadelphia, Pennsylvania

George L. Harlow, Project Director, Michigan Detroit River-Lake Erie Project, United States Department of Health, Education, and Welfare, Grosse Ile, Michigan

Richard M. Harmony, Cleveland Councilman, Cleveland, Ohio

Robert P. Hartley, Oceanographer, United States Public Health Service, Cleveland, Ohio

G. A. Harwell, Ray Weston, Inc.

Ralph A. Hazelton, Sr., President, Hazelton Plumbing and Heating, Inc., North Olmsted, Ohio 44070

Walter M. Heine, Regional Sanitary Engineer, Pennsylvania Department of Health, Meadville, Pennsylvania

R. R. Henderson, Superintendent, Water Treatment, Toledo, Ohio 43605

Robert D. Hennigan, Director, Bureau of Water Resource Services, New York State, Albany, New York

Charles E. Herdendorf, Head, Lake Erie Section, Ohio Division of Geological Survey, Sandusky, Ohio

OTHERS IN ATTENDANCE (Continued):

Gene A. Heuser, Erie Co. Comm., Erie, Pennsylvania

Jean Holderbaum, Water Chairman, East Cleveland League of Women Voters, Cleveland Heights, Ohio

Frank F. Hooper, Biologist in Charge, Inst. Fish. Res., Michigan Department of Conservation, University of Michigan, Ann Arbor, Michigan

Charles R. Hornick, The Associated Press, Cleveland, Ohio

Vincent H. Hourigan, Chief, Operations Division, United States Army Corps of Engineers, Buffalo, New York 14207

Louise W. Hubbs, Clveland, Ohio 44130

Harry L. Jackson, Cleveland, Ohio

Leo A. Jackson, Councilman, City of Cleveland, Cleveland, Ohio 44108

Harlan E. Jewett, Plant Chemist, General Tire and Rubber Company, Ashtabula, Ohio

Mrs. Henry J. John, Council on World Affairs, Cleveland, Ohio 44118

Mrs. Donald A. Johnson, President, League of Women Voters, Beria, Ohio 44017

Paul A. Johnson, Industrial Waste Analyst, City of Akron, Ohio, Kent, Ohio

OTHERS IN ATTENDANCE (Continued):

Tom Johnson, Sandusky Register, Sandusky, Ohio

L. E. Jones, United States Department of Commerce, Cleveland, Ohio

Mrs. Robert E. Jones, Water Resources Committee, Akron League of Women Voters, Akron, Ohio 44313

E. M. Joseph, Executive Vice President, Industrial Publishing Company, Cleveland 15, Ohio

W. H. Jukkola, Technical Coordinator, Industrial Wastes and Chemical Service, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania 15230

George B. Kasik, Esq., Council, Bay Village, Ohio, Cleveland 13, Ohio

William Q. Kehr, Project Director, GLIRBP, United States Public Health Service, Elmhurst, Illinois

John B. Keller, Pollution Control Inspector, Air and Water Pollution Control Division, Toledo, Ohio 43605

James L. Kerwin, Reporter, The Detroit News, Detroit, Michigan

A. M. Killin, Manager, Union Carbide Corporation, Ashtabula, Ohio

Clyde E. Kirsch, Superintendent, City of Cleveland, Cleveland, Ohio 44125

OTHERS IN ATTENDANCE (Continued):

F. W. Kittrell, Chief, Pollution Evaluation, United States Public Health Service, Cincinnati, Ohio

A. Klain, Senior Planner, Regional Planning Commission, Cleveland, Ohio 44114

Betty Klaric, Reporter, Cleveland Press, Cleveland, Ohio

Robert A. Klausner, Comptroller, Rackoff Associates, Cleveland, Ohio

William L. Klein, Chemist-Biologist, Ohio River Valley Water Sanitation Commission, Cincinnati 2, Ohio

Emil Kline, Chemical Consultant, Shaker Heights, Ohio 44120

H. Robert Kohl, City Engineer, City of Solon, Solon, Ohio

Vilmal Kohn, President, S. Euclid-Lynd. League of Women Voters, S. Euclid 21, Ohio

Mrs. May I. Kontor, Ashtabula, Ohio

Charles J. Kraven, Director of Government Relations, Republic Steel Corporation, Cleveland, Ohio

L. R. Kumnick, Waste Control Engineer, Sun Oil Company, Toledo, Ohio

E. J. Kunde, Chief of Laboratories, Cleveland Division of Health, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued):

G. R. Kunze, Waste Water Treatment, Roots - Connersville Specialist, Blower Division, Presser Industries, Inc., Connersville, Indiana

Cleveland Lane, Manager, Marketing Services, Goodrich-Gulf, Cleveland, Ohio

Stanley G. Laub, Painesville, Ohio

Thomas Lenahan, County Commissioners, Cleveland, Ohio

Carl Lesher, Haveoks and Emerson

Mrs. Lionel Levinson, Water Committee, Cleveland Heights, Ohio

Robert L. Lisker, Research Engineer-Chemical, New York Central System, Collinwood, Ohio

T. Lisowski, Chief Chemist, Union Carbide Corporation, Ashtabula, Ohio

John L. Locker, General Plant Superintendent, Sohio Chemical, Lima, Ohio

Albert W. Locuoco, Comm. Air and Stream Pollution Control, Cleveland, Ohio

Joe Lombardo, Cleveland, Ohio

Mrs. Ina Mackey, Water Resources Chairman, Painesville League of Women Voters, Painesville, Ohio

Paul E. Maloney, Regional General Manager, International Pipe and Ceramics Corporation, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued):

R. E. Manson, Engineer, Akron, Ohio, Cuyahoga Falls, Ohio

R. J. Manson, Ohio Department of Health

John A. Marsh, Superintendent of Filtration, Cleveland, Euclid, Ohio

Rihollis Matherly, Post Master, Bellevue, Ohio 44811

Mrs. H. Merkle, League of Women Voters, Cleveland, Ohio

Joe S. Metcalf, Monsanto Company, St. Louis, Missouri

A. D. Miller, President, Carbon Processing Company, Cleveland 13, Ohio

Perry E. Miller, Assistant Director, Division of Sanitary Engineering, Indiana State Board of Health, Indianapolis, Indiana

Robert J. Millstone, Rand Development Corporation, Cleveland, Ohio

Zelda W. Milner (Mrs. T. M.), Chief, Research and Publicity, Cleveland Field, United States Department of Commerce, Cleveland, Ohio 44101

Darrel D. Mitchell, Research Manager, Chemical Division, Pillsbury, Minneapolis, Minnesota

OTHERS IN ATTENDANCE (Continued):

Larry Mitchell, Public Health Service, Cleveland, Ohio

Max L. Michtell, Chief Engineer, Miami Conservancy District, Dayton, Ohio

Edward F. Mohler, Jr., Foreman, Chemical Section, Sun Oil Company, Toledo, Ohio 43601

F. W. Montanovi, Assistant Commissioner, New York State Conservation Department, Albany, New York

Albert G. Moore, Secretary, Committee on Industrial Wastes, Cleveland Chamber of Commerce, Cleveland, Ohio

Mrs. William L. Morse, Water Resource Chairman, Rocky River League of Women Voters, Rocky River, Ohio

Don Mortimer, Assistant Executive Secretary, Academy of Medicine, Cleveland, Ohio

Carl L. Mosely, Jr., Executive Assistant, Ohio Division of Wildlife, Columbus, Ohio 43212

Mrs. W. Newton Mote, League of Women Voters, Hudson, Ohio

T. R. Mulvihill, Assistant Regional General Manager, International Pipe and Ceramics Corporation, Cleveland 22, Ohio

Elizabeth W. Musy, Biochemist, New York Central Railroad, Cleveland, Ohio 44110

OTHERS IN ATTENDANCE (Continued):

Edward A. Muto, Councilman, Third Ward, Ashtabula City, Ashtabula, Ohio

Daniel E. Myers, Plant Engineer, Allied Chemical Corporation, Cleveland, Ohio

Ralph A. McAllister, Cleveland, Ohio

Albert C. McCann, Manager Plant Engineering, Ford Motor Company, Cleveland, Ohio

Lee M. McClurg, Cuyahoga County Director, Ohio Conservation, Cleveland 4, Ohio

John R. McCord, Director of Marketing, Ferro Corporation, Cleveland, Ohio 44105

Merle M. McCurdy, United States Attorney, Cleveland, Ohio

Mark McElroy, County Recorder, Cleveland 14, Ohio

Mrs. John McLaren, Water Pollution Committee, Euclid, Ohio

William J. McNally, Administrator, Cleveland Plumbing Ind., Cleveland, Ohio

James McWilliam, Bellevue, Ohio

Kenneth M. Mackenthun, Aquatic Biologist, Cincinnati, Ohio

Mrs. Allan B. MacLaren, Hudson League of Women Voters, Hudson, Ohio

OTHERS IN ATTENDANCE (Continued):

Kenneth S. Nash, Vice President, Cleveland Chamber of Commerce, Cleveland, Ohio

Gail Gianasi Natale, United States Press International, Cleveland, Ohio

Mrs. John Nichols, Conservation Chairman, Chagrin Gardens Forum, Chagrin Falls, Ohio

Thomas F. Noonan, The Illuminating Company, Cleveland, Ohio

Richard E. Norman, Market Analyst-Chemical Engineer, B. F. Goodrich Chemical and Cleveland Junior Chamber of Commerce, Lakewood 7, Ohio

Charles W. Northington, LEPO Director, Cleveland, Ohio

Suzan Northington, Cleveland 30, Ohio

Proctor Noyes, Consultant, Stanley Engineering Company, Ohio

Robert G. Nuttle, Chief Chemist, Cabot Titania Corporation, Ashtabula, Ohio

Mrs. Grace B. Oakley, League of Women Voters, Cleveland 32, Ohio

Dr. Paul Olynyk, Associate Professor, Penn College, Cleveland, Ohio

Stanly A. Orlowski, Lorain, Ohio

OTHERS IN ATTENDANCE (Continued):

C. R. Ownbey, Chief, Planning and Reports Branch, GLIRB Project, Public Health Service, Department of Health, Education, and Welfare, Chicago, Illinois

Lieutenant Commander John A. Packard, Chief, Law Enforcement Branch, 9th Coast Guard District, United States Coast Guard, Cleveland, Ohio

Dave Papier, Chairman, Pollution Control

G. E. Parker, Cleveland 13, Ohio

Anthony Pecyk, Councilman, Cleveland, Ohio

Gordon Peltier, Director of Commerce, State of Ohio, Columbus, Ohio

Ralph J. Perk, County Auditor, Cleveland 13, Ohio

Charles F. Perry, Plant Engineer, Detrex Chemical Industries, Ashtabula, Ohio 44004

Mark A. Peters, Director, Oakwood Village Recreation Association, Oakwood Village, Ohio

Ira L. Porter, Regional Director, Natimal Wildlife Federation, Oberlin, Ohio

John W. Potter, Mayor, City of Toledo, Toledo, Ohio

T. W. Powers, Commander, United States Coast Guard, Cleveland, Ohio

Jos. J. Lo Presti, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued):

William E. Price, Mayor, Solon, Ohio

Charles C. Quarles, Technical Superintendent, E. I. duPont deNemours and Company, Cleveland, Ohio

Richard Raddant, Managing Editor, Iron Age Magazine, Philadelphia, Pennsylvania

Carl C. Radder, President, S. A. Petersburg Audubon Society, S. A. Petersburg, Florida 33704

John M. Rademacher, Department of Health, Education, and Welfare, Denver, Colorado

David C. Rankin, Assistant Editor, Business Week

Mrs. Ray M. Rapp, Water Resource Chairman, Mentor League of Women Voters, Mentor, Ohio

Bertram C. Raynes, Vice President, Rand Development Corporation, Cleveland, Ohio

John Reed, Assistant General Manager, May Company, Cleveland, Ohio

I. John Reimers, Ohio Chamber of Commerce, Columbus, Ohio

Donna Rhodes, Intern, Greater Cleveland Assoc. Foundation, Cleveland, Ohio

John E. Richards, Engineer in Charge, Sew. & I W, Ohio Department of Health, Columbus 16, Ohio

OTHERS IN ATTENDANCE (Continued):

Charles V. Riley, Biol. Sci. Chem. Prof. of Biol., Kent State University, Kent, Ohio

J. V. Robillard, Chief Chemist, Monsanto Company, Trenton, Michigan

Art Robinson, Director, Public Relations, Ohio Department of Health, Columbus 16, Ohio

Mrs. Donald Root, President, Mentor, Ohio, League of Women Voters, Mentor, Ohio

David Rose, Shaker Heights, Ohio

Daniel Rose, Shaker Heights, Ohio

Mrs. William L. Rose, Shaker Heights 20, Ohio

Dale Z. Rowe, Marketing Specialist, United States Bureau of Commercial Fisheries, Rocky River, Ohio 44116

Gene Ruehle, Alken Murray Corporation, Lyndhurst, Ohio 44124

Jack R. Ryan, Director of Public Relations, Olin-Mathieson, New York, New York

David Sachs, Cleveland, Ohio

John R. Sager, Superintendent of Water Utilities, City of Cuyahoga Falls, Cuyahoga Falls, Ohio

A. E. Saikaly, Chief Deputy County and Sanitary Engineer, Geauga County, Chardon, Ohio

OTHERS IN ATTENDANCE (Continued):

Norman E. Sanders, Resident Engineer, Cleveland Office, United States Army Engineer District, Buffalo, Cleveland, Ohio

Joseph E. Sarosy, President, Lake County Industrial Development Council, Painesville, Ohio

Willard F. Schade, Chief Engineer, Willard F. Schade and Associates, Cleveland, Ohio 44114

Robert G. Scharff, Quality Control Supervisor, Olin-Mathieson Chemical Corporation, Ashtabula, Ohio

Edwin F. Schlensker, Superintendent, City of Euclid, Euclid, Ohio

Rosemary Schlensker, Member, League of Women Voters, Euclid, Ohio

R. G. Schverger, Cleveland Electric Illuminating Company, Manager, Civil Mechanical Engineering, Cleveland, Ohio

Mrs. P. W. Schwan, Akron, Ohio 44313

Mrs. Homer A. Scott, Member, League of Women Voters, Euclid, Ohio 44119

Ann Scoville, League of Women Voters, Cleveland 5, Ohio

Stephen J. Seresta, Consulting Sanitary Engineer, Cleveland, Ohio

Thoams F. Serity, Bay Village, Ohio

OTHERS IN ATTENDANCE (Continued):

A. E. Settle, Public Relations Director, Manufacturing Chemists Association, Washington, D. C.

Ruth W. Seymour, League of Women Voters, Cuyahoga Falls, Ohio

A. M. Shannon, Chief, Water and Sewage Treatment, Detroit Department of Water Supply, Detroit, Michigan 48226

Allan M. Shapiro, Assistant Sanitary Engineer, United States Public Health Service, Parma Heights, Ohio

Milan J. Siebert, Manager, Ohio Contractors Association, Cleveland 29, Ohio

George D. Simpson, Partner, Haves and Emerson, Engineers, Cleveland 14, Ohio

R. L. Simpson, Superintendent ofFiltration, City of Cleveland, Cleveland, Ohio

Kenneth J. Sims, Mayor, City of Euclid, Euclid 23, Ohio

Robert C. Singer, Public Relations Director, The Soap and Detergent Association, New York, New York 10017

Henry Sinkiewicz, City Councilman, Cleveland 5, Ohio

Othello H. Skinner, Senior Chemist, City of Cleveland, Cleveland, Ohio 44110

Curtis Lee Smith, President, Cleveland Chamber of Commerce, Cleveland, Ohio 44115

OTHERS IN ATTENDANCE (Continued):

George P. Smith, Executive Director, Cuyahoga River Reclamation Commission, Cuyahoga Falls, Ohio

J. Glen Smith, Commissioner of Health, City of Cleveland, Cleveland, Ohio

Mrs. Mary E. Soeder, Lakewood 7, Ohio

George T. Sohl, Mayor, Olmsted Falls Village, Olmsted Falls, Ohio 44138

George B. Sowers, Consulting Engineer, Cleveland, Ohio

Estal E. Sparlin, Director, The Citizens League, Cleveland, Ohio 44115

Mrs. D. M. Speros, Vice President, League of Women Voters, Painesville, Ohio

John M. Stackhouse, Director, Ohio Department of Agriculture, Columbus, Ohio

Andrew D. Staursky, Assistant Director of Public Relations, United States Steel Corporation, Cleveland, Ohio

Evelyn Stebbins, Water Resource Committee, League of Women Voters, Rocky River, Ohio

Stephen Suhajcik, Commissioner Fiscal Control, Cleveland Utility Department, Cleveland, Ohio 44114

Darrel G. Suhre, Senior Associate Civil Engineer, City of Detroit, D.W.S., Detroit, Michigan 48223

OTHERS IN ATTENDANCE (Continued):

Dave W. Sullivan, Sales Engineer, Orangeburg Manufacturing Company, Aurora, Ohio

Miss Frances J. Sullivan, County Editor, The Telegraph, Painesville, Ohio

Stanley H. Sutton, Partner, Havens and Emerson, Cleveland, Ohio

Mrs. Ethel G. Swanbeck, State Representative, Erie County, Huron, Ohio

Michael A. Sweeney, State Representative, Ohio Legislature, Cleveland 13, Ohio

Howard W. Swift, Assistant Director, Garden Center of Greater Cleveland, Cleveland 6, Ohio

Page Swing, Sales, Pickands Mather and Company, Cleveland 14, Ohio

John Symick, Cleveland Teacher's Union, Cleveland, Ohio

Judith Lynn Taylor, Publi. Health Service, Cleveland, Ohio

W. R. Taylor, Manager, Engineering Services, Diamond Aikan Company, Cleveland, Ohio

R. W. Teater, Assistant Director, Department of Natural Resource, Columbus, Ohio

W. A. Tiburski, Councilman, Oakwood Village, Oakwood Village, Ohio, Bedford, Ohio P.O.

OTHERS IN ATTENDANCE (Continued):

James S. Timonere, Councilman, Ashtabula, Ohio

John C. Toomey, Regional Sales Manager, Rex Chainbelt, Inc., Bay Village, Ohio

V. P. Traina, Sanitary Engineer, Republic Steel Corporation, Independence, Ohio

William C. Treon, Reporter, The Plain Dealer, Cleveland, Ohio

Fred E. Tucker, Coordinator Health Engineer, National Steel, Weirton, West Virginia

Mrs. Dwight Van Buren, State Water Committee, League of Women Voters, Hudson, Ohio

Mrs. C. C. Van Vechten, County Program Chairman, League of Women Voters, Cleveland 19, Ohio

M. A. Veigel, Area Manager, NALCO Chemical Company, Solon, Ohio

James L. Verber, Oceanographer, United States Public Health Service, Chicago, Illinois

Tom Vilt, Vilt Realty, Maple Heights 37, Ohio

Jim Viny, President, Ball Construction Company, Cleveland, Ohio 44109

John E. Vogt, Director, Division of Engineering, Michigan Department of Health, Lansing, Michigan

Harry L. Vonderwert, Peerless Cement, Detroit, Michigan

OTHERS IN ATTENDANCE (Continued)

Henry J. Vyhnalek, Supervisor, Plant Chemistry, Cleveland Electric Illuminating Company, Cleveland 1, Ohio

W. R. Wagoner, Assistant Engineer, Ohio Department of Health, Columbus, Ohio

Mrs. Ruth Walker, League of Women Voters, Cleveland Heights, Ohio

J. Warren, United States Public Health Service, Defiance, Ohio

Wm. M. Wasick, Public Utilities Commission, City of Akron, Akron, Ohio

Mrs. Neil Waterbury, Northwest Ohio Natural Resource Council, Toledo, Ohio 43623

Charles Watts, Superintendent of Sewage Treatment, North Olmsted, Ohio

P. J. Weaver, Director, San. Eng. Res. Services, Procter and Gamble, Cincinnati, Ohio

Joseph C. Webber, Chief Engineer, Toledo, Ohio Division of Water, Toledo, Ohio 43605

Mrs. Kathryn M. Weible, League of Women Voters, Euclid 17, Ohio

T. G. Weigle, Jr., Planner, State Development Department, Columbus, Ohio

Peter S. Weill, Project Supervisor, Diamond Alkali Company, Cleveland, Ohio

OTHERS IN ATTENDANCE (Continued)

Edward Wellesus, Reporter, Erie Times, Erie, Pennsylvania

C. R. Westmoreland, Assistant Cuyahoga County Sanitary Engineer, Cleveland, Ohio

Jack L. White, Attorney, Squire, Sanders and Dempsey, Cleveland, Ohio, 44115

P. M. Wilkins, Technical Manager, Mobil Oil Company, Trenton, Michigan 48183

Mrs. Leon G. Williams, Northwest Ohio Natural Resources Council, Toledo 12, Ohio

John R. Wirts, Superintendent, Easterly Pollution Control Center, Cleveland, Ohio 44110

Harry P. Wiseman, Public Relations Manager, Diamond Alkali Company, Cleveland, Ohio

John R. Wolfs, Chief Civil Engineer, Division of Water Pollution Control, City of Cleveland Department of Public Utilities, Cleveland, Ohio

L. S. Wright, Pollution Control Engineer, Ashland Oil and Refining Company, Ashland, Kentucky

C. V. Youngquist, Chief, Division of Water, Ohio Department of Natural Resources, Columbus, Ohio

Mrs. Frank Zack, League of Women Voters of Rocky River, Rocky River, Ohio 44116

OTHERS IN ATTENDANCE (Continued):

Anthony Zalimeni, President, Council, Ashtabula, Ohio

Everett F. Zurn, Federal Water Pollution Control Advisory Board, Zurn Industries, Erie, Pennsylvania

Basil Kontoyianes, Consultant, Enforcement Branch, Public Health Service, Washington, D. C.

PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

MR. STEIN: The conference is open.

This conference in the matter of pollution of the interstate and Ohio intrastate waters of Lake Erie and its tributaries, involving the States of Indiana, Michigan, Ohio, Pennsylvania, and New York, and the U. S. Department of Health, Education, and Welfare, is being held under the provisions of section 8 of the Federal Water Pollution Control Act. [illegible], 1965

Under the provisions of the Act, the Secretary of Health, Education, and Welfare is authorized to call a conference of this type when requested to do so by the Governor of a State, and when on the basis of reports, surveys, or studies he has reason to believe that pollution of interstate waters subject to abatement under the Federal Act is occurring.

In a letter dated June 11, 1965, to the Honorable Anthony J. Celebrezze, Secretary of the Department

Included in the report are data on: Congressional inquiries and answers on pollution; Aquatic biology; water quality; industrial wastes, and other data of Health, Education, and Welfare, Governor James A. Rhodes of Ohio requested that a conference be called to consider pollution of Lake Erie. Governor Rhodes' letter to Secretary Celebrezze is as follows:

"Dear Secretary Celebrezze:

"The recent Governors' Conference on Great Lakes Pollution held at Cleveland, Ohio, at my invitation, provided evidence that there are wide-spread contributions to the pollution problem of Lake Erie.

"It is true that state and local agencies are making definite progress toward pollution abatement in Lake Erie. However, because of the numerous pollution sources, both within and outside of the State, and because of the national significance of this fresh water resource, it is apparent that the Federal government has a responsibility in this matter.

"Under these circumstances it appears that any effective pollution abatement program regarding Lake Erie should involve local, state, federal and even international cooperation, and such is our desire. I am therefore requesting that you call a Federal Pollution Conference as soon as possible to institute a plan of action to improve Lake Erie water quality.

"You may count on the complete cooperation of this office and our various state agencies in conducting such a conference.

"Sincerely,
"JAMES A. RHODES
"Governor"

In accordance with that request and on the basis of reports, surveys, or studies, a notice of conference was sent to the official State water pollution control agencies of Indiana, Michigan, Ohio, Pennsylvania, and New York.

The purpose of the conference is to bring together the State water pollution control agencies, the representatives of the Department of Health, Education, and Welfare, and other interested parties to review the existing situation, the progress which has been made, to lay a basis for future action by all parties concerned, and to give the States, localities, and industries an opportunity to take any indicated remedial action under State and local law.

Opening Statement - Mr. Stein

The conference technique is rather an old one. It is used by many State agencies informally in the normal conduct of their business in the field of water pollution control. The concept of the conference was proposed by the United States Supreme Court as long ago as 1921 in the famous case of New York against New Jersey involving interstate pollution. I would like to quote from this Court opinion:

> "We cannot withhold the suggestion, inspired by the consideration of this case, that the grave problem of sewage disposal by the large and growing population living on the shores of New York Bay is one more readily to be most wisely solved by cooperative study and by conference and mutual concession on the part of representatives of the States so vitally interested in it than by proceedings in any court however constituted."

We strongly support the conference technique and we measure our success by the situations which are solved at the conference stages, rather than by the court actions we bring.

This is a conference between the official

State water pollution control agencies of Indiana, Michigan, Ohio, Pennsylvania, and New York. These agencies are the Indiana Stream Pollution Control Board, the Michigan Water Resources Commission, the Ohio Department of Health, the Pennsylvania Sanitary Water Board, and the New York State Department of Health. These agencies may bring whomever they wish to the conference and have them participate in the conference. However, only the representatives of the official State agencies and the Department of Health, Education, and Welfare constitute the conferees.

The State of Indiana has designated as its conferee for the conference Mr. Blucher Poole; Michigan will be represented by Mr. Loring Oeming; Ohio will be represented by Dr. E. W. Arnold, George H. Eagle, and Fred E. Morr; Pennsylvania will be represented by Mr. Richard Boardman; and New York will be represented by Mr. Robert D. Hennigan. Mr. H. W. Poston of the Department of Health, Education, and Welfare, with headquarters in Chicago, Illinois, has been designated as conferee for the Federal Government.

My name is Murray Stein. I am from Washington, D. C., headquarters of the Department of Health, Education, and Welfare.

Opening Statement - Mr. Stein

Both the States and the Federal Government have responsibilities in dealing with water pollution control problems. The Federal Water Pollution Control Act declares that the States have primary rights and responsibilities for taking action to abate and control pollution. Consistent with this we are charged by law to encourage the States in these activities. However, the Secretary of Health, Education, and Welfare also is charged by law with specific responsibilities in the field of water pollution control, in connection with pollution of navigable and interstate waters which endangers the health or welfare of any persons. The Act provides that pollution of such waters, whether the matter causing or contributing to such pollution is discharged directly into such waters, or reaches such waters after discharge into a tributary of such waters, which endangers the health or welfare of any person, is subject to abatement. The Act also states that the Secretary shall call a conference at the request of the Governor of any State if that request refers to pollution of interstate or navigable waters which is endangering the health or welfare of persons. We may only call a conference on intrastate situations at the request of a Governor.

Pollution of the Great Lakes has long been a matter of concern, not only to the Department of Health, Education, and Welfare, but to the State and local water pollution control agencies and citizens throughout the Great Lakes area. Pollution of Lake Erie is an integral part of the problem of the pollution concerning all the Great Lakes.

Two previous Federal-State enforcement conferences have been held concerning pollution of the Great Lakes. On March 2-9, 1965, an enforcement conference was held on the pollution of the interstate waters of the Calumet Rivers, Wolf Lake, and Lake Michigan between Indiana and Illinois. At the conference, the conferees initiated a program of remedial action to protect the water quality for the maximum number of legitimate water uses.

On December 6, 1961, John B. Swainson, then Governor of Michigan, requested that the Secretary of Health, Education, and Welfare call a conference on pollution of the navigable waters of the Detroit River and the Michigan waters of Lake Erie. The first session of the conference was held March 27-28, 1962. The conferees recommended that an investigation and study be initiated to gather necessary data and information on the waters involved. A second session of this conference was held on June 15-18, 1965. The conferees agreed on action to be taken to abate pollution.

The conference today on the interstate and Ohio intrastate waters of Lake Erie and its tributaries is another important step forward in solving the pollution problems of the Great Lakes.

I can't tell you how important it is that we take action, if action is indicated, as early as possible. I think you all recognize that the Great Lakes constitute our greatest single fresh water resource in the country. The Great Lakes are not only necessary to the well-being of this section of the country, but the well-being of the Nation itself.

In estuary waters or in river waters, when we clean up a pollution problem, we wait for one, two or three cycles, either of tides or of spring pressures, and generally the stream is clean if we stop the pollution causes. We are not so sure that this will happen with the lakes. Lakes throughout the world have been known to degrade, gradually or rapidly.

The miracle has been that the Great Lakes in this continent have remained fresh, so I think it behooves us, if there is a pollution problem, to be sure that we can control it as rapidly as possible, because there is no guaranteed cleansing action after this happens, and any degradation that has taken place may be with us for a long time, and if we wait, this may get more and more serious.

Now a word about the procedure governing the conduct of the conference. The conferees will be called upon to make statements. The conferees, in addition, may call upon participants whom they have invited to the conference to make statements. At the conclusion of such statements, the conferees will be given an opportunity to comment or ask questions, and at the conclusion of the conferees' comments or questions, I may ask a question or two.

This procedure has proven effective in the past in developing a clear statement of the problem and in reaching agreements on equitable solutions.

At the end of all statements, we will have a discussion among the conferees and try to arrive at agreement on the facts of the situation. Then we will attempt to summarize the conference, giving the conferees, of course, the right to amend or modify the summary.

Under the Federal Law, the Secretary of Health, Education, and Welfare, is required, at the conclusion of the conference, to prepare a summary of it which will be sent to all the conferees. The summary, according to law, must include the following.

1. Occurrence of pollution in interstate and navigable waters subject to abatement under the Federal Act;
2. Adequacy of measures taken toward abatement of pollution; and
3. Nature of delays, if any, being encountered in abating the pollution.

Subsequent to the conference, the Secretary of Health, Education, and Welfare is required to make recommendations for remedial action, if such recommendations are indicated.

A record and verbatim transcript will be made of the conference by Mr. Al Zimmer. This is made for the purpose of aiding us in preparing a summary, and also providing a complete record of what is said here.

We will make copies of the summary and transcript available to the water pollution control agencies of Indiana, Michigan, Ohio, Pennsylvania, and New York. We have found that, generally, for the purpose of maintaining relationships within a State, that the people who wish transcripts should request them through their State agency rather than come directly to the Federal

Government. The reason for this is that we would prefer that the people who are interested in the problem to follow their normal relations in dealing with the State agencies on these matters rather than with the Federal Government when the conference has been concluded. This has worked successfully in the past and we will be most happy to make this material available to the States for distribution.

I would suggest that all speakers and participants, other than the conferees, making statements come to the lectern and identify themselves for the purpose of the record.

At this point, I would like to indicate what most of you know already, I think, that Mayor Locher and his staff have very kindly joined us at the head table and are watching, and will participate in these proceedings with much interest. They are certainly welcome.

First, we would like to call upon the man who, in his position as Governor, called this conference, a man who, as is evidenced in his public statements and in private talks, has been acutely aware of the resources problems of America, the resources problem of this area, and particularly the pollution problem of Lake Erie.

Governor James A. Rhodes

Governor Rhodes.

(Applause.)

STATEMENT OF HONORABLE JAMES A. RHODES, GOVERNOR OF THE STATE OF OHIO

GOVERNOR RHODES: Thank you, Mr. Stein.

Mayor Locher, distinguished guests here on the panel, and ladies and gentlemen;

I know that Mr. Stein did not do this purposely. After all, he is a new citizen of our community here in the past 72 hours. He referred to the good Mayor of Cleveland as Mayor Locher.. The Mayor whispered in my ear and he said he can't hardly stand this three months before election.

(Laughter.)

Also, he wanted me to announce that he has arranged to have Detroit play here tonight with the Cleveland Indians.

(Laughter.)

Secondly, we want to express our appreciation and gratitude for the concentration of interest that you do have in this hearing.

Governor James A. Rhodes

I am going to be very brief and concise in my remarks. I think that we should look upon and view and observe this hearing and this panel as constructive and with some optimism.

We have a job to do here in the Great Lakes. We have 41 per cent of the population, we pay 45 per cent of all the taxes, and I think that your effort, your endeavor here today, is worthwhile to save the Great Lakes, not only Lake Erie. I know some people believe it's only in your own backyard. This is the Great Lakes, the fight to save the Great Lakes, the industrial basin of these United States of America, and it is important especially to the employment and to the future of this great nation.

I want to congratulate all of you. We are here to achieve and to accomplish a program of success in the Great Lakes Basin here, and especially here in Lake Erie.

I want to repeat what I said in the letter and what I told Mr. Stein in Detroit. He has our fullest cooperation.

There are some 400 people here this morning who have evinced interest in the pollution here of the Great Lakes. I do not believe that this is a platform to be motionless. We have a job to do and we want every-one to be heard. We all want you to express yourselves concerning the pollution problem of Lake Erie and the Great Lakes.

As I came in the door I met a friend of mine, the Mayor of a small community here, and he said to me, "Governor, I'm a great deal like the fellow that was being taken out of town on a rail." Had it not been for the honor, he would just as soon walk.

(Laughter.)

So this is in a spirit of cooperation and coordination. We are here to aid, assist and to help. No one here today is going to do anything except one thing, and that is join hands and do everything that we possibly can to clean up the pollution in Lake Erie.

In that spirit, I want to welcome all of you here. And to Mayor Potter of Toledo, Mayor Locher, and to the rest of you, I want to commend you for your fine cooperation in this.

Again, this is in the hands of the panel and Mr. Stein. Do not hesitate to express yourselves and, as we say, lay it on the line, because we are here to build and construct a better State. I know we have the representatives of the other Great Lakes States here and they have just as much concern and as much interest as we do here in the State of Ohio.

Again, I want to thank each and every one of you. We hope that this is a highly successful conference and a highly successful panel, and it can only be that way if you approach this in a constructive manner, and the way we want it in the end, the ultimate being to do a job here on Lake Erie and the rest of the Great Lakes.

Thank you very much.

(Applause.)

MR. STEIN: Thank you, Governor.

I scarcely got out of the locker before I got sent back to the showers.

(Laughter.)

Mayor Locher, I hope the Indians do better tonight.

(Laughter.)

We now have the distinct pleasure of calling on one of your Congressmen from the area.

We in Washington have a phrase for certain kinds of Congressmen. We call them "working Congressmen." A "working Congressman" is one who studies the issues, assiduously attends committee meetings, understands a lot about the subject, and probably keeps busy sixteen, eighteen and twenty hours a day. They seem to have the springs to keep moving.

I would say that on the basis of experience you have one of the "workingest Congressmen" in Washington from this area. He is a real expert on resources and certainly the pollution problem of this area, as well as on tax and other matters.

Generally speaking, when we deal with Congressmen, we are briefing them. In this case, I must say that this Congressman has done most of the briefing and it has gone the other way. We have learned from him.

At this point I would like to call on Congressman Charles A. Vanik.

Congressman Vanik.

(Applause.)

STATEMENT OF HONORABLE CHARLES
A. VANIK, CONGRESSMAN, 21ST
DISTRICT OF OHIO

CONGRESSMAN VANIK: Mr. Stein, ladies and gentlemen of the conference:

I want to be very brief in these remarks. I am privileged to have the opportunity to speak so early in your program, but I appreciate it, because we have business in Washington to which I must return.

First of all, I want you to know that what I say here I think is pretty much supported, or at least the interest in the Lake Erie pollution problem is very much supported by my colleagues in Congress. Both of the United States Senators from Ohio, and our northern Ohio delegation locally, as well as those of the other adjoining areas have been very, very much concerned about the problem of Lake Erie pollution.

I come here as a lifelong resident of this community. I have seen the progressive deterioration of the Lake. I remember there were times I could fish and swim in the Lake within commuting distance of Cleveland, and I can't very well do that now. I think we have all noticed that development in our lifetimes.

Today the lake is neither safe nor pleasant for either bathing or fishing within a substantial drive of this community. At the present rate of deterioration we may soon have to make provisions for water supply from our rivers and streams before they reach the Lake. The entire economic future of this community is critically threatened by the disastrous destruction of this community's resources.

Gentlemen of the conference, I am not here to present specific facts as to the extent of the deterioration or the contamination of the lake or as to the specific causes of the pollution. I think you have in your combined State and Federal resources adequate fact-finding and fact-gathering resources, which are expert and which are complete.

As a matter of fact, the splendid report which has just been released by the Division of Water Supply and Pollution Control of the Department of Health, Education, and Welfare well documents the case, basically outlines the problem, and carefully points toward recommendations with which there can be no disagreement.

On March 2, 1965, I directed a letter to the Secretary of Health, Education, and Welfare, the distinguished Clevelander, Mr. Anthony J. Celebrezze, requesting a Federal conference.

On March 6th, 1965, I received a reply from Mr. James Quigley indicating the lack of authority for the Federal Government to enter into this matter unless interstate pollution were proven.

I would like to insert in the record at this point my letter to Secretary Celebrezze, and I would also like to insert into the record the letter which I received from Assistant Secretary James Quigley.

MR. STEIN: Without objection, that will be done.

CONGRESSMAN VANIK: Thank you.

(The letters referred to above are as follows:)

Congressman Charles A. Vanik

"March 2, 1965

"Honorable Anthony J. Celebrezze
Secretary of Health, Education, and Welfare
330 Independence Avenue, S. W.
Washington, D. C.

"Dear Mr. Secretary:

"It has come to my attention that your office has today established a Chicago conference on Lake Michigan water pollution under authority of Federal law. The statutes authorize a conference for the purpose of establishing a voluntary program of pollution cleanup as an alternative or preliminary to litigation initiated by the Federal Government.

"Current studies by the Public Health Service will undoubtedly prove that Lake Erie is the largest body of critically contaminated fresh water in the world. It will further be established that there is a dual standard of pollution emission tolerances on the Great Lakes as distinguished from rivers and waterways where downstream users can more readily observe and control the degree of pollution.

"Our community, as you know, has become thoroughly incensed at the deterioration of Lake Erie. Conditions are becoming worse. At the present rate of contamination, our water supply intakes may have to be moved farther into the lake at a staggering cost which local communities cannot afford and which they should not be made to bear. Pollution is less expensive and more properly treated at its source rather than its destination.

"In view of Federal jurisdiction over Lake Erie and its navigable tributaries a Federal water pollution conference is long overdue. Since the northern Ohio urban complex has the greatest immediate stake in the good fresh water supplies of Lake Erie, such a conference would most suitably be held in Cleveland.

"It is my hope that a Cleveland conference can be immediately scheduled, particularly since the Lake Erie studies by the Public Health Service are substantially completed.

"Sincerely yours,

"Charles A. Vanik
"Member of Congress"

"DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Washington, D. C. 20201
Office of The Secretary

"Dear Mr. Vanik:

"Thank you for your letter of March 2, 1965 in which you urge that the Secretary call a conference to be held in Cleveland, Ohio, in the matter of the pollution of Lake Erie, such as the conference which convened in Chicago, Illinois on that date in the matter of the pollution of Lake Michigan and the Calumet River system.

"The Lake Michigan and Calumet conference was called under that provision of section 8 of the Federal Water Pollution Control Act which authorizes the Secretary of Health, Education, and Welfare to take such action whenever, on the basis of reports, surveys, or studies, he has reason to believe that any pollution of interstate or navigable waters in or adjacent to any State or States is endangering the health or welfare of persons in a State other than that in which the discharge or discharges originate is occurring. Our reports and surveys of the Lake Michigan-Calumet River area indicated that sewage and industrial wastes originating in Indiana were causing pollution in Illinois, and that sewage and industrial wastes originating in Illinois were causing pollution in Indiana. In the face of this interstate pollution, it was appropriate to convene the conference.

"The quality of the waters of Lake Erie is of concern to this Department. As part of the Great Lakes-Illinois River Basin Project, Lake Erie and the Lake Erie drainage basin are and have been under study by the United States Public Health Service. The Project's basic objectives are to determine the causes of pollution and its effect on water quality and beneficial uses. Unfortunately, from the point of view of being able to give a positive response to your request, while our study to date has pinpointed many and extensive pollutants in the Lake we have not yet been able to identify any of these as being interstate in nature. Lacking such evidence, the Secretary does not have the authority to call a conference on his own initiative.

"However, I would point out that under the law, the

Secretary can call a conference in the matter of intrastate pollution of interstate or navigable waters when requested to do so by a governor of a State. In fact this Department currently has under way an intrastate enforcement action in the Detroit area of Lake Erie which grew out of a request from the Governor of Michigan. In the absence of such a request from a governor, the Secretary of Health, Education, and Welfare may not call a conference in the matter of pollution which originates in Ohio and endangers the health or welfare of persons only in Ohio or New York State pollution which adversely affects only New Yorkers. Should the governor of any State which borders on Lake Erie make a request for Federal enforcement action, it would receive prompt and serious consideration.

"Further, should our Lake Erie study or any other information we receive give us reason to believe that pollution of the waters of Lake Erie originating in one State is endangering the health or welfare of persons in another State, we would exercise our responsibilities under the Act.

"I share your concern about the pollution of Lake Erie. Historic uses of the Lake have been impaired.

Others are in jeopardy. The responsibilities of this Department under the Federal Water Pollution Control Act will be fully exercised toward the restoration of the quality of Lake Erie's waters.

"Sincerely,
"James M. Quigley
"Assistant Secretary"

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Congressman Charles A. Vanik

My interest in this matter goes back a long, long time, and of course I was happy when Governor Rhodes called for this Federal conference after the State conference which we had right here in this hotel a few months ago.

I feel that when we come to this matter of pollution control, the first thing we should do in the Federal Government is look at ourselves, and I think we ought to look critically at our own efforts.

At this point, I would like to direct attention to the correspondence and the communications that I have had with the Corps of Engineers concerning the dumping of fill in the north breakwall of Lake Erie just at the harbor entrance.

I reported this matter to the Corps of Engineers on May 12, 1965. I directed this matter to the attention of Lieutenant General W. K. Wilson, Jr., Chief of the Army Corps of Engineers, Department of the Army, at Washington, D. C.

I would like to submit in the record at this point my letter to him as Exhibit 3.

(The letter referred to above is as follows:)

Congressman Charles A. Vanik

"May 12, 1965

"Lt. Gen. W. K. Wilson, Jr., Chief
Army Corps of Engineers
Department of the Army
Washington, D. C. 20315

"Dear General Wilson:

"It has recently come to my attention that the Corps of Engineers is currently reviewing contracts for the dredging of the Cuyahoga River. Under the terms as I understand them, the dredged material is transported by barge and dumped on the north side of the Government breakwall just outside the Cleveland harbor entrance.

"Last Monday, May 10th, at a meeting on the pollution problem of Lake Erie called by Governor James Rhodes of Ohio, I directed attention to this situation and criticized this action of the Federal Government which contributes to the pollution problem of Lake Erie. Because of the heavy industrial complex along the Cuyahoga River and the extensive return of polluted water, the solid matters of contamination fall to the bottom and are included in the siltation which is dredged under the Army Corps contract. When these dredged materials including undissolved pollutants are dumped on the north side of the Government breakwall, the contamination spreads throughout the Lake adding to the concentrations of chlorides, phenols, cyanides, iron scale and phosphates, as well as petro-chemical combinations.

"I was startled to learn that the Federal Government contributes to the Lake Erie pollution problem -- which another Federal agency is investigating.

"Will you kindly consider a modification of this contract to provide for the dumping of these dredged materials in a 'contained land fill' at the Burke Airport in order to reduce the contamination of the Lake through the dredging process. Although the dredging process in the past has not been the total contributor to lake pollution, it nevertheless provides a substantial source of pollution which can be readily abated.

"Please advise me on this matter at your earliest opportunity.

"Sincerely yours,

"Charles A. Vanik
"Member of Congress"

Congressman Charles A. Vanik

In early May I received a cursory reply from Lieutenant Colonel S. W. Pinnell, Assistant Director of Civil Works for Central Divisions of the Corps of Engineers, stating that a reply to my letter was being prepared. Subsequently, on May 21, 1965, I wrote again to Lieutenant General Wilson requesting that before contracts be let for this year's dredging, determination be made as to the feasibility of taking the dredged material and dumping it into a landfill at Burke Lakefront Airport.

I would like this letter included in the record.

(The letter referred to above is as follows:)

Congressman Charles A. Vanik

"May 21, 1965

"Lt. Gen. W. K. Wilson, Jr., Chief
Army Corps of Engineers
Department of the Army
Washington, D. C. 20315

"Dear General Wilson:

"Several days ago I received a letter from Lt. Col. S. W. Pinnell, Assistant Director of Civil Works for Central Divisions of the Corps of Engineers, stating that the Director of Civil Works is studying my letter of May 12, 1965, in which I recommended that the Corps of Engineers terminate the dumping of dredged material from the Cuyahoga River into Lake Erie on the north side of the Government breakwall just outside of the Cleveland harbor. It was my contention that when these dredged materials including undissolved pollutants are dumped into Lake Erie, the contamination spreads throughout the Lake adding to the concentrations of chlorides, phenols, cyanides, iron scale and phosphates, as well as petro-chemical combinations.

"Before your office or the Civil Works Division of your office makes a final determination on this matter, and before contracts are let for this year's dredging, I request that you arrange for the taking of siltation cores in the Cuyahoga River, upstream from the Cleveland industrial complex as well as downstream from the industrial complex so that a determination can be made of the extent of the contamination of the Cuyahoga River with solid matter contamination caused by the Cuyahoga Valley industries.

"It should be feasible to scientifically determine the extent and the composition of the undissolved pollutants. This should determine the necessity for terminating the dumping of dredged materials into the open Lake.

"I am also asking the Public Health Service to cooperate in this matter so that the extent and nature of the pollution in the river may be determined. The Public Health Service can also determine whether or not the dumping of dredged materials into Lake Erie is harmful and detrimental to the public health and welfare.

"Sincerely yours,

"Charles A. Vanik
"Member of Congress"

Congressman Charles A. Vanik

On July 2, 1965, I received a letter from Major General Jackson Graham, Director of Civil Works for the Corps of Engineers, Office of the Chief of Engineers of the Department of the Army, who advised me that "The annual maintenance dredging in Cleveland harbor, including the Cuyahoga River and old river channels, amounts to about 1.2 million cubic yards at a cost of approximately $975,000. This material is deposited lakeward at the easterly breakwater. It is recognized that the disposition of dredged material outside the breakwater affects local sedimentation rates, but there is no evidence that these operations have been detrimental to shore installations or beaches. Any pollutants from the rivers and harbors which may be deposited in the lake by the dredging operations would be normally carried out by natural current action. While the dredging and disposal operations may accelerate this transport, it does not add anything to the pollution problem.

"Extension of the Burke Lakefront Airport would accommodate approximately two million cubic yards of material. The placement of this material would require a retaining bulkhead estimated to cost approximately a million dollars plus an additional $750,000, material rehandling costs. Assuming that this area has the capacity to accept dredged spoil for a two-year period, the cost of normal maintenance dredging for this period would increase from approximately $2,000,000 to $3,750,000. In accordance with present practices, local interests would be required to furnish the required bulkhead and assume the additional operating costs in making this landfill.

"In summary, there is no evidence that the dumping of dredged material lakeward of the breakwater actually contributes to the pollution of the area, although it is recognized that the rate of transport of pollutants through the lake may be accelerated by this operation. While the disposal of dredged material behind dykes or bulkheads may have a limited effect upon the amount of pollutants in the water, there is no indication that the benefits which would be derived from such an operating procedure would be commensurate with the annual increased cost of some $875,000.

"Further, if the cost of project maintenance were increased to such a level, it might adversely affect the future justification for any additional improvements to the project."

On July 13, 1965, I wrote a letter to Major General Jackson Graham, in which I state:

"I do not agree with your determination

that this disposition of dredged material is not detrimental to the water quality of Lake Erie. There is no doubt that your methods of dredging and disposal accelerate the transport of polluted materials into Lake Erie. In substance, your letter states that the benefits derived from depositing this material behind a retaining bulkhead would not justify the added cost of such an operating procedure to the extent of $875,000 a year.

"I cannot understand how the United States Corps of Engineers can refuse to deposit dredged material behind a retaining bulkhead on the basis of increased costs. At this very moment dredged material at East Chicago Harbor, Indiana, is being pumped behind bulkheads under circumstances where the United States Steel Corporation holds an option to buy such developed lands. At Indiana Harbor, Indiana, it is my understanding that the Corps of Engineers is also depositing dredged material behind bulkheads or a large portion of landfill, on which the

> Inland Steel Corporation holds an option for purchase or use after the landfill is completed.
>
> "It is impossible for me to understand how your office could justify the added expenditure of the disposition of dredged material on land for private use and refuse to create similar landfills of dredged materials for public purposes, such as, the Burke Lakefront Airport in Cleveland.
>
> "If the Corps of Engineers has found a way to avoid the dumping of pollution-laden, dredged materials into Lake Michigan, I am sure a way can be found to avoid the dumping of contaminated, dredged material in Lake Erie."

Up to the present time, gentlemen, I have not received a reply from the Corps of Engineers. I hope that this conference may be more successful than I in receiving a satisfactory reply from the Corps of Engineers to the questions I have raised in my last letter.

The second point I want to make at this conference is this: It has come to my attention that the State of Ohio tolerates dual standards for water pollution control in the Ohio River Basin and the Lake Erie Basin. We find along the Ohio River substantially all of the industries that we find along the shores of Lake Erie, such as the steel industries and the petro-chemical industries. Along the Ohio River and largely as a result of the compact entered on the Ohio River Basin, the downstream users of Ohio River Valley water have insisted upon and have received higher standards of water pollution control.

At this point in the record, Mr. Chairman, I would like to insert a copy of a letter which I addressed on October 6, 1964, to Mr. Henry Sinkiewicz, Chairman of the Committee on Air and Water Pollution of the Cleveland City Council.

In this letter I set forth the differences in the various operations along the river as compared with the Great Lakes Basin in the making of steel.

I pointed out that along the river basin less than four pounds of dust per ton of steel are permitted in the waste returning to the river.

I pointed out the existence of scale receiving basins after the making of steel.

I pointed out that in the cold rolling process the emulsified oil which is placed on the steel as it passes through the rollers is collected and diverted to water basins where it is skimmed off the surface of water or precipitated by chemicals, after which the water emerges reasonably clear for re-use.

These operations don't exist in our valley here. I don't believe they exist in Detroit.

In the coke oven operations along the Ohio River valley the hydrogen and methane gas when leaving the coke ovens is cooled with water sprays which condense the tar and dissolve the ammonium salts. In subsequent recovery processes a liquor is discharged containing a variety of organic compounds, among which the most objectionable are the phenols, which cause a bad taste in water.

Along the Ohio River Valley the industry cools the red hot coke with this liquor, thus decomposing some of the phenols and driving off the remainder in steam. Some other industries recover the phenol and remove it entirely.

Mr. Chairman, I will submit this letter for the record.

(The letter referred to above is as follows:)

Congressman Charles A. Vanik

"October 6, 1964

"Mr. Henry Sinkiewicz, Chairman
Committee on Air and Water Pollution
City Hall
Cleveland, Ohio

"Dear Mr. Sinkiewicz:

"In connection with your committee's work on the Cuyahoga River water pollution problem, I recommend that a determination be made by your committee to determine whether the industrial plants of the Cuyahoga valley are making every practicable effort and using every known and approved procedure to reduce the current outpouring of pollution into the river.

"The steel, petroleum and chemical industries which presently put their waste into the river have the primary responsibility to protect the lake which must ultimately receive the sum total of waste discharge.

"A large body of water like Lake Erie has an assimilative capacity that has already been exceeded. Official government reports have indicated that at the bottom of the Lake Erie basin ferrous, sulphide-petro-chemical emulsion has been steadily rising over the lake bottom. This concentration of waste on the lake bottom is growing in area and in depth -- destroying organic life and the capacity of the lake to develop orderly self-purification.

"I have not been able to fully determine what corrective processes can be developed for the petroleum and the chemical industries, but there are basic water pollution procedures which should be followed by the steel-making industry, and I recommend that your legislation provide a mechanism for determining whether their procedures are being properly followed on the Great Lakes.

"Operation 1 -- When ore is reduced to molten iron in the blast furnace, the gas generated in the process is washed with water in equipment that removes 98 percent of the dust it carries. During the smelting the furnace shell must be cooled, so a supply of water is circulated through hollow metal plates imbedded in the refractory lining; it is then pumped to the gas washer. The washer water is clarified in large settling basins.

"In this operation two hundred pounds of dust are produced with every ton of iron made. With proper settling, less than four pounds of dust per ton should appear in the waste flowing into the river.

"Operation 2 -- A scale of iron oxide, which forms on the surface of hot steel, is blasted loose by streams of water under high pressure as the metal is rolled into desired shapes. The scale is carried by water to a basin where most of it settles, but the finest particles settle very slowly.

"The amount of mill scale discharged may be very small, but it tends to discolor streams for a short distance. The recovery of mill scale can be brought about through further settling and the use of precipitators.

"Operation 3 -- In the cold rolling process a continuous strip of steel passes between a series of rolls to reduce its thickness, simultaneous with a steady stream of emulsified lubricant being played on its surface. Emulsified oil, however, neither settles nor floats.

"Suitable chemicals have been found to cause the oil to rise to the surface of the water where it can be skimmed off, there is also a new technique now being developed which provides for absorption of oil on the precipitate formed by chemicals -- after which the water emerges crystal clear and is returned for re-use.

"Operation 4 -- The hydrogen and methane gas when leaving the coke ovens is cooled with water sprays which condense the tar and dissolve the ammonium salts. In subsequent recovery processes a liquor is discharged containing a variety of organic compounds. Among the most objectionable are the phenols that can cause a bad taste in drinking water after it is chlorinated.

"The prevention of pollution by Operation 4 is by cooling the red hot coke with this liquor, thus decomposing some of the phenols and driving off the remainder in steam. The other and preferable method is to recover the phenol and remove it entirely.

"The production of steel, chemicals and oil are not clean industries. Our concern should be directed to determine whether these industries are following pollution-control procedures in keeping with general standards for the industry.

"The water-pollution procedures which are set forth above are the industry standards for the steel industry as reported in the official industry publications. These standards are strictly complied with by the steel industries of the Ohio Valley and the industrial tributaries of the Ohio, where the water must be cleansed for the re-use of downstream users. There is no reason why lesser standards should apply to the outpouring of industrial waste into the Great Lakes.

"I urge that the legislation you are drafting will not overlook the necessity for preserving the Great Lakes as a source of usable fresh water supply.

"Very truly yours,
"Charles A. Vanik
"Member of Congress"

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Congressman Charles A. Vanik

In this connection, I do not know the extent to which these water pollution control procedures are followed by the Lake Erie Basin industries. My suspicion is that they are substantially disregarded and that the pollution wastes of the steel and petro-chemical industries pour practically unrestrained into Lake Erie.

As a matter of fact, we have a permit system where we give permits for industries to pollute the lake and our river. The theory of the permit procedure was that it would afford time for industry to develop economical and wise techniques of water pollution control within a reasonable period of time.

During the time of my observation of this permit system, I have seen the output of pollution multiply many times over instead of it being abated.

The great water-polluting industries threaten all of us with shut-down or relocation, if we unreasonably pressure them for the installation of water pollution procedures and devices. They contend that economically they cannot afford the installation of expensive devices and continue in business.

The question which I raise now to this conference is: Can we tolerate a lower standard for the control of industrial pollution on the Great Lakes than we permit in the great river valleys of America? If the steel and petro-chemical industries of the Ohio River Valley can afford the added cost of water pollution control which they now do, why, then, can we not expect the same standard from the same industries using substantially the same producing processes on the Great Lakes?

If the industries of the Great Lakes Basin are permitted to continue to produce pollution without restraint, it is these industries which enjoy a competitive advantage which their competitors do not, at the price of public health and the future prosperity of the Great Lakes region.

I want to recommend to this conference that in its deliberations determinations be made to ascertain the extent to which industries of the Great Lakes Basin endeavor to control pollution, as compared with the same industries in the Ohio River Valley. Then I recommend that time tables be established to determine how long a time should be allowed to bring the Great Lakes industries up to the Ohio River Basin standards in industrial pollution control.

In America we are seeking uniform standards of water quality. We should also endeavor to establish uniform standards relating to the industrial use of water. It seems to me incumbent upon this conference and the Division of Water Pollution Control, both Federal and State. to establish uniform criteria on the industrial use of water, so that a steel plant on Lake Erie will use and cleanse water in the same manner and to the same extent as does the same industry in the Ohio River Valley. The same principles should apply to the petroleum industry and each of the other water-polluting industries. The reconditioning or cleansing of industrial water is basically the same for each of these specified industrial users.

It seems to me that uniform, acceptable practices ought to be established and followed in all parts of the country and with respect to all of the sources of water. We who use the fresh waters which pass by our shores have an obligation to ourselves as well as to the people who live downstream from our community. They are entitled to water as pure and as good as it can be made. Our efforts should be untiring until we achieve that goal.

The people who live in Cincinnati and Louisville must drink water which has already passed through many industrial and through many municipal uses. Water pollution control has made that water tolerable and acceptable. There is no reason why the River Raisin in Michigan, the Indiana Harbor or East Chicago Rivers, the Maumee, or the Cuyahoga should be used any differently than we use the Ohio. The causes of water pollution can be almost pinpointed. In the Great Lakes basins of these rivers the flow of pollution is visible to the eye and readily perceptible to the nose.

We are all gravely concerned with the future of the Great Lakes Basin. Never before have we been so seriously threatened as we are now. Our good water was our greatest resource. The industries which need it will soon be leaving us because the water which they need may not be satisfactory or suitable for their uses.

I pray, gentlemen, that we can win this battle in trying to save Lake Erie's water. I hope that we can start our way today on a victory toward an enemy which can destroy the great value of this vital resource to the community of Ohio, to the community of Cleveland and northern Ohio.

Thank you very much.

(Applause.)

MR. STEIN: Thank you very much.

As you realize, there will be many points raised by the different speakers, and these points will be taken up as we progress.

If there are any comments from the conferees, we will hear them now.

(No response.)

MR. STEIN: I think Representative Vanik has raised many interesting points, and I am sure these points will be given consideration by the conferees and the technical representatives as the conference goes on.

I would like to just make one comment though. I think we pointed out before that because of the nature of the Great Lakes, it may be that the water quality requirements here may not just have to be equal, but they may have to be better than they are in other places where we have the flow of a river or a tide.

I would like to point, right at the outset, to the two conferences that we had, one in Chicago and one in Detroit. I know of no place in this country where they came up with higher requirements than we did for the lower end of Lake Michigan, and for Detroit we practically did the same.

We have to bear in mind that in dealing with the lake we may be dealing with something that is not reversible, and we have to exercise considerable and due care.

With that, we would like to go on to the next presentation from Michigan, Congressman Dingell, who, as many of you know, has been a long friend of water pollution control and an expert on it in the Congress.

Congressman Dingell has sent a short statement. I think he was probably out in the midwest last week, in Independence, with the signing of the Medicare Bill, and he is tied up in Washington, but we will have Mr. Peter Kuh of our staff read that statement.

Mr. Kuh.

Congressman John D. Dingell

STATEMENT OF HONORABLE JOHN D. DINGELL, 16TH DISTRICT OF MICHIGAN, AS READ BY MR. PETER KUH

MR. KUH: This is the statement of the Honorable John D. Dingell, Democrat, Sixteenth District of Michigan, to the Cleveland Conference on Pollution Abatement in Lake Erie:

"Mr. Chairman, for the record, my name is John D. Dingell. I am a Representative in Congress from the Sixteenth District of Michigan.

"My District is vitally concerned with the purity and quality of the Detroit River, a major contribution to Lake Erie, and to the purity of the Lake itself. The northern border of my District is at the foot of West Grand Boulevard in Detroit and it runs a substantial distance down the Detroit River and Lake Erie to the confluence of the Huron River, which at that point provides the southern border of my District.

"The people of my District are heavily dependent upon the waters of the Detroit River and Lake Erie for industrial and municipal use, for recreation and aesthetics, for fish and wildlife, and for transportation of people, products, and raw materials to and from market, at home and abroad.

"The purity of these waters is of the utmost importance to them.

"I commend the Governors of the States adjacent to Lake Erie for requesting this conference, something which I suggested on April 14th. It offers the most promise, and indeed the only chance for cleanup of Lake Erie before it has declined to one vast ecological wasteland.

"The former Governor of our State of Michigan, the Honorable John B. Swainson, requested convening just such a conference as this on the Detroit River and the Michigan waters of Lake Erie and their tributaries. That conference has just passed its second stage and has the endorsement of citizens, our Governor, municipal leaders, and conservationists. Extensive studies and recommendations have been completed. Means for implementation are now being studied by the Michigan Water Resources Commission, the appropriate state agency, acting in concert and cooperation with the United States Public Health Service. The cleanup of a major portion of Michigan's contribution to the destruction of water quality in the Lake Erie Basin is now in sight.

"As I pointed out to that Conference, this can be accomplished with minimal hardship to industry and municipalities, and with incalculable benefit to all.

"This same glittering prospect is in sight for the whole Lake Erie Basin, if the concerned State agencies, Governors, industries, and municipalities will cooperate as they can and should.

"The saving of Lake Erie, now 25 per cent barren from pollution, is in the hands of this conference. Time is running out. I urge vigorous, effective action."

MR. STEIN: Thank you, Mr. Kuh, and thank you, Congressman Dingell, for that statement.

At this point we would like to call on Mr. H. W. Poston for the Federal presentation.

Mr. Poston.

STATEMENT OF MR. H. W. POSTON,
CONFEREE, DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE, CHICAGO,
ILLINOIS

MR. POSTON: Thank you, Mr. Stein.

H. W. Poston

Fellow Conferees, members of the conference:

I am very happy to be here today to participate in this conference.

First, I would like to say that we will have Dr. Clarence Tarzwell, Mr. Grover Cook and Mr. Stephen Megregian present the Federal story on pollution in the Great Lakes.

We will also have the Corps of Engineers, the Department of the Interior, and the Department of Agriculture, who have indicated that they would like to make statements.

We also have the United States Coast Guard here today, who have indicated that they do not have a statement, but if there are particular questions we may be calling upon them.

We also have experts from within the Public Health Service on bacteriology, biology, and in various scientific categories, who will be available to answer any questions that may be posed by the conferees.

I am Regional Program Director for Water Supply and Pollution Control in five States, the States of Wisconsin, Michigan, Illinois, Indiana and Ohio, with headquarters in Chicago.

I would also like to recognize Mr. Earl

Anderson, who has a very great interest as Regional Program Director out of New York, and his area of interest is also around these Great Lakes, particularly at the east end, and in Pennsylvania and New York.

I said I was very happy to participate in this conference today, this being the fourth conference that I have been involved in this year. I think this conference has the distinction of being the biggest that the Public Health Service has carried on, and I say it is the biggest because it involves the most states.

It involves one of the Great Lakes, which is our greatest fresh water resource, not only in this country, but in the world.

It involves 10,000 square miles of fresh water, and it involves some ten million people, and it involves the use of this water for public water supply, for industrial water supply, recreation, for fish and wildlife, for aquatic life, and for other legitimate uses.

Yesterday we took a trip, and I might recommend this same trip to those of you who have not already seen the Cuyahoga River. We took this trip in some pretty nasty weather, but it wasn't nearly as nasty as that river was yesterday.

H. W. Poston

We saw everything in the field of pollution. We saw oil and we saw sewage and we saw grease and sediment. We saw a very serious and complex problem laid right out before our eyes. We didn't need any interpretation of our scientific people to tell us that there is a problem here.

Well, this is the problem that we are here to talk about today.

For some two and a half years, the Public Health Service has been studying the Great Lakes, and we have had our scientific personnel, our chemists, our biologists, bacteriologists, oceanographers, engineers, hydrologists, all participating in this study, and they have studied the lake from Buffalo to Detroit. They have studied it at Toledo. They have made studies up and down the lake to find out about this thing, water quality, which we are concerned with here today, and the degradation of this quality due to pollution.

I said that I am happy to be here, and another reason that I am happy to be here is because I think we have something to contribute to this conference, something to contribute in terms of damages from pollution, the causes of pollution, and the solutions to this very complex and serious pollution problem which we will talk about here today.

We have first Dr. Clarence M. Tarzwell, as I have indicated, who will tell us something about the changes in the Great Lakes.

Dr. Tarzwell has recently changed titles from Director of Aquatic Biology Research at the Sanitary Engineering Center in Cincinnati, to in Charge of Aquatic Biology Research at the National Marine Water Quality Research Laboratory in Kingston, Rhode Island.

I think we are honored to have Dr. Tarzwell here, because in 1963 he was named Ohio Conservationist of the Year. This was given by the Ohio people here.

I would like now to present Dr. Tarzwell.

(Applause.)

MR. STEIN: Dr. Tarzwell, before you start, I think most of the panel up here know him, but for those who don't, I think this is the opportunity where, if we have any questions on biology, this is the time to ask them.

Dr. Tarzwell is our Senior Biologist, and if you have ever been to an international meeting or have followed this field, this is no place to qualify an expert, but I think it is well recognized internationally that Dr. Tarzwell is the outstanding aquatic biologist in the field of water pollution control today, and this is evidenced in papers and in attending international meetings.

I would think it is a privilege for us to have Dr. Tarzwell here, and I think one of the evidences of the importance we all place on the biological problems of Lake Erie is that Dr. Tarzwell found time to come here personally and make this presentation.

Dr. Tarzwell.

Clarence M. Tarzwell

STATEMENT OF DR. CLARENCE M. TARZWELL, IN CHARGE OF AQUATIC BIOLOGY RESEARCH, NATIONAL MARINE WATER QUALITY RESEARCH LABORATORY, KINGSTON, RHODE ISLAND

DR. TARZWELL: Mr. Chairman, Mr. Stein, Conferees, ladies and gentlemen:

The problems facing us today have no easy solution, but they are of great importance to all of us now and in the future.

Can we maintain a desirable environment for ourselves and the generations yet to come? Are deteriorating soil, air and water resources a necessary result of our so-called progress? Must we accept unsightly, odoriferous, and contaminated streams and lakes as an inevitable result of the growth of our population and the development of our industries?

It seems that many have. I do not believe that we must do this.

In our rush for immediate creature comforts and the so-called better things of life, we have forgotten the environmental conditions under which we evolved. We have not given consideration to the effects of our activities on our overall natural environment.

Man has now attained the ability to drastically and dangerously damage his own environment. In many instances he is his own worst enemy. He has and is damaging his environment knowingly or unknowingly.

Wastes of ever-increasing variety and quantity are being discharged into our air and water with little consideration of their direct, let alone their indirect or long-term effects on our environment and well-being.

For some years, however, there have been voices of conservationists crying in the jungle of resource exploitation and waste dumping. With continued increase in the numbers, complexity and quantity of our wastes, these voices have become louder and more persistent.

That we cannot indefinitely continue to pour our untreated wastes in ever-increasing quantities into our lakes and streams from which we take our water supplies is becoming increasingly apparent.

Finally, at least a portion of the public has been awakened to the threat to our general well-being, our health and welfare. We hear more and more about abatement and prevention of pollution.

But, what is pollution? Just how is it defined?

Clarence M. Tarzwell

When is a water polluted?

Pollution is a term which has come to be very loosely used. It has many meanings to different people. Different people have different definitions of pollution, and there is not agreement on what pollution may be or when pollution occurs. If we could get some agreement, I believe that a good deal of the argument that takes place in some of these conferences would be eliminated.

Let us consider some of the definitions of pollution that have been advanced. Some have maintained that any change in the primordial condition is pollution.

All streams were not originally the same, so we cannot make them all the same. The forests of the eastern part of the country have been removed. We cannot bring all streams of this area back to conditions that existed when the country was forested. I do not feel that there is hope of attaining this, or that it would always be desirable.

Others have said that the addition of any material to a stream is pollution, and they have designated all wastes or materials discharged into a stream as pollutants. This is not always so. Under this definition, if you put a little distilled water into a stream, it would be a pollutant.

Clarence M. Tarzwell

Certain compounds and elements are found in water. The addition of certain materials or the increase of these materials can be beneficial.

We all know and believe in soil fertilization, where we add certain trace elements and certain nutrients to improve our crops. These materials are not considered harmful; they are beneficial. They increase production. We can, in many instances, fertilize our waters to a certain extent by the addition of these materials.

All materials are not harmful in the same way, and materials which may constitute a pollutant for one use are not necessarily pollutants for another. For example, let's consider organic wastes or sewage. If we put small amounts of these materials into a stream that is used for navigation or power, the results are usually indifferent. They seem to have very little effect and are more or less neutral. However, with a different type of stream results can be different. Let us consider a stream coming from a high mountain area in the northern portion of the country which is very cold and low in dissolved solids. Such a stream is not very fertile. If our objective is fish production and we add a little bit of sewage which enriches the stream and increases fish production, how is that pollution? How can such an addition be pollution when it increases the yield of the desired product?

On the other hand, if we take this same waste, the sewage waste, and put it into a stream that we are using for a source of domestic water supply, it does constitute pollution.

Therefore, the mere addition of a material or waste is not necessarily pollution, but it can be.

Others have claimed that any change in the quality or character of a water constitutes pollution. Let us assume that we have two streams. One coming from a limestone area is a hard-water stream. Another, draining a sandstone area, is soft. They both produce fish. When they join, the character of the water is changed, but this resulting stream can in itself be good for the production of fish. Such a change in character is not pollution.

Let us consider a stream in Glacier National Park where the water is very cold and low in fertility. In this area the trout grow very slowly and they mature at a small size. The fishery is very limited. A little bit of warming of the water would improve the stream by increasing the growth rate. In this instance changing the character of the stream by adding the warm water would not be pollution, if trout production were the desired use.

Selenium is considered a very toxic material. However, it is one of the trace elements needed for life. Thus its mere presence is not necessarily harmful. It is only when you get too much that it becomes harmful.

In certain sections of the country we add iodine to our table salt. We add fluoride to our drinking water to prevent decay in children's teeth. All of these materials, if added in excessive quantities, are harmful. This contradicts the attitude that "if a little bit is good, a whole lot is better."

Toxicity is a quantitative term. Too much of anything can be toxic.

I think you all recall the incident when babies were poisoned when salt was substituted for sugar in a hospital. Salt is needed for life, but too much is toxic.

It's the same way with fertilizers. Correctly done, fertilization is beneficial, but if we put too much on our lawn or on our potatoes, we burn and destroy them.

We can also have overfertilization of our waters because the addition of large amounts of nutrients can cause excessive growths and changes in environmental conditions are undesirable. They interfere with certain of our uses. It may be swimming, it may be boating, or it may be aesthetic enjoyment.

We should not add large quantities of heated water to warm waters. The adding of hot water very often constitutes pollution.

We have discussed the benefits of certain dissolved solids. While they may be good in some areas, they are an outstanding problem in our irrigation waters because they get so high that the water is no longer satisfactory for irrigation.

Therefore, the use of a water determines largely what is going to cause pollution.

We may classify our various water uses under eight main headings. (1) Domestic or municipal use, which is the highest. (2) Water for agricultural use, that is, irrigation or stock watering. Of course, for irrigation we must have water free of concentrations of materials which are toxic to plants.

(3) We want water that is satisfactory for the various industrial processes. Industrial waters vary greatly in quality because of the great variety of specific uses. Some uses require very high quality water.

(4) We want water for aquaculture, that is,

the production of commercial and sport fishing and their food organisms. Sport fisheries are very important in this country, and we need water suitable for them. We want it not just for the fish. We want conditions suitable for the production of fish so we can make large catches.

(5) As far as water for navigation is concerned, we are not very particular, as long as it is not detrimental to the boats. However, pleasure boating is another matter.

(6) Water used for power may be unsuited to several other uses.

(7) For recreational use, we need more stringent classifications. Most of our recreation is water-based, and we want pure water that is not offensive to the nose and is pleasing to the sight. We like to see and hear clear water gurgling over the rocks of a stream. We want to have picnics, outings, boating, skiing, swimming in a pleasing setting. Recreational use is a multi-billion dollar business and must be considered among the most important water uses.

(8) Last, but not least, are the aesthetic values. We cannot sell them short. It is hard to put dollar values on them. What is the value of a painting?

What is the value of a sunset? Clean water values are similar.

To get some idea of what the aesthetic values are, consider the purchase of a cottage on a lake. If you have a view looking out over the lake you are going to pay much more for it than you will for one which does not have a view. I believe that the aesthetic values must be considered in any pollution problem now and even more so in the future.

With this background, I think we are ready to consider a definition of pollution. The definition I have developed for pollution resulting from man's activities is as follows: Pollution is the addition of any material or any change in quality or character of a water which interferes with, lessens or destroys a desired use.

I think in going over the classification of uses and reviewing them, you will see that everything is tied to use. If we do not have a harm to a use, there is no pollution.

In the prevention of pollution for any use the basic principle in regard to dissolved or suspended materials is that their concentration must not exceed the maximum concentration which is not harmful under conditions of continuous exposure. If these concentrations are exceeded the water is misused and pollution exists.

Therefore, probably the simplest definition of pollution is just, "too much" -- too much of anything.

Now, in regard to the question facing us: Is Lake Erie receiving too much? Is it misused, abused, and polluted?

Lately we have heard a great deal about "eutrophication." In order to define this and other terms and to understand the things that are happening in Lake Erie, I think that we should review some of the things that have happened in our smaller lakes. Aging and the adverse effects of overfertilization manifest themselves much more rapidly in small lakes and they present for us a clear picture of the results of overfertilization.

A lake is like a man. It has a birth, a youth, maturity, old age, and death. Our lakes were born in the glacial period. In their youth they were cold, clear, and had very little materials dissolved in them. They were not rich, and they were populated largely by members of the family Salmonidae. Limnologists have designated such youthful lakes as oligotrophic lakes.

As time goes on, erosion on the watershed

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brings in silt and organic material from the forest floor. This results in filling, the production of shallow bays, plant growths and the enrichment of bottom materials. As the shallow areas increase, the lake becomes warmer and there is a gradual change in the composition of the biota. As the bottom materials become richer and the bottom organisms change, there is a shift in the fish population. Finally, the stage is reached which prevails in many lakes in Wisconsin and Michigan where there are warm-water fishes, at least in the top layers; there is a thermocline, progressive depletion of DO in the deep waters, plankton blooms following turnovers and extension of rooted aquatics.

At this stage the lakes become mature and are in the stage the limnologists have called "eutrophic." Therefore, the maturing of an oligotrophic lake is called "eutrophication."

Now, as we go on toward old age, the lake gets more and more organic material, vegetation becomes much more dense and continually moves toward the center. There is a filling in, a change in the character of the water, a decrease in fish species, and we get to the stage which is called "dystrophic." I know if you have traveled in the north central States you have seen lakes in all stages of their aging. You have seen the encircling bogs extending out over the lake to form floating mats on which you can walk. These are the quaking bogs where there is water underneath. When this stage is well along we have only the mud minnow and the stickleback. The other fish have gone. The vegetation mat continues to extend and fill the lake until there is only a small circle of open water. Tamaracks advance over the bog and finally there is just a group of tamaracks, then just a meadow, and the lake is dead and gone.

We all felt that the Great Lakes were too big for anything like this to happen. They are large, but the same processes are working, but they work very slowly.

All these processes have in the past been measured in geological time, but with the addition by man of large amounts of organic material, this process has been speeded up. It has been so speeded up that we can see its effects even in the Great Lakes in one lifetime.

Many desire a summer cottage on a lake. Most prefer clean sand beaches, clear sparkling water free of algal blooms and very few rooted aquatic plant beds. On such a lake one cottage goes up and then there is a rapid development. Somebody else comes, and pretty soon there

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is a row of cottages around the lake, and then there is another row.

Then something happens. The algae grows and you get undesirable conditions. It is not so good for swimming. So the owners unite and form a group for algal control by means of copper sulphate. This doesn't meet the problem as the dead algae remain and the organic enrichment is still in the lake. They look around and blame everybody and everything except themselves and the effluents from the septic tanks which are going into the lake. Overfertilization is a reality that we must face. It can and has brought detrimental results.

With this background, let us examine the situation in Lake Erie. It presents a special problem. It is the shallowest of the Great Lakes. There is less volume for DO below the thermocline. The thermocline is that shallow layer of water between the upper circulating layer of water and the deeper more stagnant water where there is a sudden drop in temperature. As the summer advances and the surface water becomes warm, the strength of the winds can circulate only the upper layer, whereas in the fall and spring they can circulate the whole lake. The upper circulating layer is called the epilimnion. Only lakes of considerable depth, which are not continually circulated, develop thermoclines and have deep water areas which are not circulated. This area of deep non-circulating water has been called the hypolimnion. In shallow lakes there is less area in the hypolimnion to contain oxygen to carry over the summer, and you can more rapidly get depletion of oxygen in a lake of this nature than you do in the other deeper lakes.

There is a greater population around Lake Erie. There are more people adding wastes, and you have a tremendous industrial development in this area. The population here has been increasing very rapidly. There has been a threefold increase since 1916. Industry, in the meantime, has increased six to sevenfold.

Over 11 million pounds of suspended solids are added to Lake Erie each day. Over 174,000 pounds of phosphorus and 820,000 pounds of nitrogen are added to the lake each day.

Two-thirds to three-fourths of these materials come directly from municipalities. These nutrients result in greater plant growths and there has been a great increase in rooted aquatic vegetation in some areas. The filamentous algae, the kind which grows in long strands and catches on your oars like a long green slime, has also increased. After strong winds these materials have collected on the beaches in some areas to create unsightly and odoriferous conditions. Such collection of vegetation greatly reduces the value of beaches because the public doesn't care too much for it.

Further, there have been increases in the plankton. In this Cleveland area, during the period in which studies have been made, there has been a six to sevenfold increase in the plankton organisms. On the average, in the western end of Lake Erie, the number of plankters per ml have increased from 1,000 for the period 1938-1942 to 3,500 in 1964. This is a three and a half-fold increase.

In addition, there have been changes in the species of plankton. The diatoms, which are characteristic of a clear, cool water, have been displaced by green algae and then with some of the blue-green algae, which is most undesirable. Blue-green algae is increasing and dense populations have developed in some areas.

The character of the bottom has changed also. The organic content has increased and there is more flocculent material. These changes have brought about changes in the population of the organisms which live on the bottom.

As you know, in 1953 there was a great kill of the mayflies, those insects that come out in great hordes at night and cover lights, windows and trees along the shore. They were removing a lot of the organic material from the lake just by coming out this way, but they have largely been eliminated.

The caddisflies, another very important food organism for fish, have largely disappeared. These desirable fish food organisms have been replaced by the bloodworms or midges and the tubifex or sludge worms. Perhaps you have noted the sludge worms in polluted areas of small streams. Often they occur in such abundance that they form a red mat over the bottom. They live with their heads in the sludge and wave their tails in the water to get oxygen. They can live at very low dissolved oxygen levels as they simply wag their tail faster and further as the DO decreases.

These organisms, plus the fingernail clams, have increased greatly in Lake Erie bottom deposits. These organisms are not utilized to any great extent and are not satisfactory for the species that have been the most desired and the ones that were formerly so abundant.

There has been a great increase of phosphorus in the bottom deposits. It has accumulated there to levels of about 1,500 to 3,000 parts per million. This represents a much greater quantity of phosphorus than that entering the lake in any one year, and if this material comes back into solution it will create problems much greater than those observed to date.

There have been changes in the dissolved oxygen. In the past 35 years, there has been a decrease in the average oxygen level in the bottom areas of the western end of the lake from about five parts per million to two parts per million or less, and in some areas it is approaching zero.

There are large areas now where the DO is very low in the summer. Some low levels were noticed as early as 1929. Especially notable has been the reduction of the oxygen reserve in the hypolimnion. In August 1928 the hypolimnion contained 78 percent of the oxygen that was originally there in the spring, but in August 1960 this had been reduced to 25 percent. Thus, the oxygen deficit is increasing.

From 1933 to 1935, the oxygen deficit has increased 2.6-fold. In several areas there is an approach to anaerobic conditions. We are at the threshold in some areas.

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What is the importance of this situation? The results of the development of anaerobic conditions have been demonstrated in Lake Zurich in Switzerland and Lake Washington in the State of Washington near Seattle. Anaerobic conditions in a lake are the result of progressive enrichment. Organic materials steadily increase to the point where the oxygen required for their utilization by bacteria exceeds the available supply of dissolved oxygen. When free oxygen is used up the breakdown of organic wastes is undertaken by bacteria which grow in the absence of free oxygen. We then have anaerobic decomposition. Under this process certain gases are released and many materials stored in the bottom deposits are rendered soluble and return to the water. These dissolved materials and nutrients are spread throughout the entire lake at the spring or fall overturns or when the wind action is strong enough to circulate the lake waters. These nutrients greatly enrich the water and bring about dense plankton blooms. Much greater plankton blooms especially of the undesirable blue-greens have been observed following the development of anaerobic conditions. The release of the accumulated materials from the bottom of Lake Erie could result in a rapid deterioration of water quality. Thus the development of anaerobic conditions should be prevented through the reduction of organic materials being added to the lake.

There have been changes also in the fish population, in fact, rather drastic changes. The more desirable fishes have been decreasing and the less desirable fishes have been increasing. This is demonstrated by a comparison of the average catch for the 20's and 30's with catches in the 1960's.

The normal catch from the lake compared to the 1960 catch for four species, cisco, whitefish, bluepike and sauger, demonstrates a reduction of 99.92 percent. For walleyes, a comparison of the catch in 1936 with that in 1960 indicates a reduction of 99.96 percent.

There has been an increase in the carp, goldfish, shad, alewives and smelt.

What are the reasons for this shift? There could be several, but one outstanding reason is the change in environmental conditions which has made these areas more suitable for the coarse fishes and less suitable for the more desirable sport and commercial fishes. The direct and indirect effects of the change of only one factor in the environment can be quite striking. To illustrate this I would like to tell you about an experiment a man carried out in Canada. He was carrying on long-term studies to determine the oxygen requirements of trout. Of course, since these were long-term he had to provide food for the trout. To do this he put some minnows in the test chamber. Everything went along fine for a time; but as the study advanced, he noted that the trout appeared to be starving in the presence of an abundant supply of minnows.

He wondered what was the matter. He investigated and found that under the reduced oxygen conditions the environment became more suitable for the minnows, which were more adapted to low oxygen levels, and the minnow could outswim the trout.

What did he do? He just took them out, took a scissors and clipped the tails off the minnows, and everything was rosy. But we can't do that in nature.

(Laughter.)

Another example of these effects is the great increase of carp in many waters. When this occurs, fishermen often ask, "What's the matter? Are the carp eating the bass?" No, the carps don't have to eat the bass in order to reduce their number. You don't have to have a fish eat another fish to exterminate or reduce the numbers of that fish. You do not have to put in a toxicant that is acutely and rapidly toxic in order to wipe out a fish species. It can be brought about slowly through competition for space and food, or through a gradual change in the environmental conditions so they are more suitable for another species.

To illustrate this point, let's say you have a 10-acre pasture and you put ten cows in it and then you say, "Well, I'm going to do a little better, so I'll put in 100 goats." Your cows will do very, very poorly, but the goats wouldn't eat a single cow.

(Laughter.)

The same thing can happen in the aquatic environment.

It may be pointed out that we still have many pounds of fish produced in these organically enriched areas. That is true, but both quality and quantity are important. Out in your garden, if you don't hoe the weeds, they take over and your lettuce, radish, beans and tomatoes do very poorly. If you are interested merely in producing a large quantity of vegetation, why grow the vegetables? Just grow the weeds. You would get more production per unit or acre, but you don't want weeds. You want lettuce or tomatoes or radishes, and you knock out the weeds because they are interfering with what you want. They are interfering with the use that you desire.

This can happen in the aquatic environment. When environmental conditions favor the weed species they take over and seriously limit or eliminate those species not favored by the changes. We have briefly outlined some changes that have taken place in Lake Erie. The subsequent speakers will give you the evidence indicating that these changes have occurred.

Now, what are our conclusions in regard to Lake Erie? Changes have occurred in Lake Erie. There has been bacterial contamination. Beaches have been closed. There have been changes in the bottom organisms with the production of a less desirable form from the standpoint of fish food. There have been changes and increases in the rooted aquatics and increased growths of the filamentous algae. There have been increases in the overall plankton population, changes in the composition of the population, and blooms of undesirable forms have occurred in several areas.

There have been decreases in the dissolved oxygen and anaerobic conditions are threatened.

There have been increases in the weed species and decreases in the more desirable species of commercial and sports fishes.

Recreational uses have been damaged and the aesthetic values have deteriorated.

The conclusion that we come to is that these uses have been lessened or damaged. Therefore, Lake Erie is polluted.

Conditions are now such that we can have rapid changes. We are approaching anaerobic conditions in some areas. The phosphorus is almost at critical levels in considerable areas in Lake Erie. If extensive anaerobic conditions develop we can expect much more extensive algal blooms.

The record is clear. We know through observation the effects of organic enrichment in the small lakes. We have noted the beginning of such changes in Lake Erie.

This problem is real. It won't go away if we ignore it. It is on our door step and, in this instance, the old saying that an ounce of prevention is worth a pound of cure is very applicable.

It has been said that we should live in the present, for the future, being guided by the past. I think the record is clear. We know what has happened in the past. We want to live now so that we can improve conditions for the future.

The studies that have been made have shown that economically feasible methods do exist and are available for the reduction of nutrients.

This problem is urgent. Our aquatic resources are well worth our best efforts for their preservation. In fact, they are essential for our very existence.

We must act now to restore and maintain this great resource for ourselves and for the generations yet to come.

(Applause.)

MR. STEIN: We will now see if there are any comments or questions.

I should indicate that the comments and questions must come from the conferees. We can't open this to the floor. Otherwise, we will take up permanent residence in Cleveland.

(Laughter.)

But if you do feel you have a question, see your State representative and he may be able to ask it, or if you appear, you can save it for your statement.

Mr. Oeming.

MR. OEMING: Dr. Tarzwell, you made the

statement toward the end that phosphorus is approaching a critical level in Lake Erie.

I wonder if you could specify what is a critical level for phosphorus?

DR. TARZWELL: In the presentations that are to come, this is going to be detailed a little more fully. However, let me give you some of the data that we have recently secured in our experiments to determine the phosphorus needed for algal growth and the amount that would cause considerable growths. We have found that the amount required for growth is not the same for all species and algae are able to store enough phosphorus in their bodies, if it is available, so that they can go through five generations.

In other words, just a study of the phosphorus that may be in the water at any one time is not a reliable index of the problem because all of it could be tied up in the organisms. Unless you determine total phosphorus including that contained in the plankton organisms, you could miss the boat. In our studies we found that we had to starve these organisms through several generations before we could tell the phosphorus that was actually needed for their growth. For some species the minimum amount which will just support growth is about a hundredth of a part per million.

The amount that will cause a bloom varies with the species, and it is anywhere from about .03 to .05 ppm, depending on the species. I believe in the presentations which will follow it is stated that about .03 ppm total phosphorus is the critical amount.

This is somewhat of an average. As I say, it differs for the different species, and we haven't studied all the species yet. You could question this because you might say, "Well, look, we're having a bloom with a lower level of phosphorus." It might be an algae that didn't need so much phosphorus.

There are thousands of species, so there can be exceptions to all the rules, but if you give an average, you're pretty much in the ball park.

MR. OEMING: Well, I guess I have to pursue the question a little further now that you have discussed this.

First of all, what are we talking about? Are we talking about phosphorus, total phosphorus, when we talk about .03?

DR. TARZWELL: It is my understanding that the report deals with total PO_4 but perhaps this should be checked with Mr. Cook. However, as I have said, there are specie differences in the algae, and I can't answer you on what all species would need because we do not have the information yet. We just have what we have studied. This is perhaps a range.

MR. OEMING: Are we in a situation where we can't say, with any degree of certainty or reliability, that a certain phosphorus level will do a certain thing in Lake Erie?

DR. TARZWELL: Let's be practical. If we are going to preserve our water resources, we must use what knowledge we have now and put it to use to do the best we can to meet the problem, because I don't think we are ever going to study all the species of algae in this world and tell what level of phosphorus may cause a bloom, so we have to use a level that is somewhat of an average in order to meet the problem the best we can.

We can't wait until we find all the answers. Everything could go to pot in the meantime, but we will suggest a level, and then if future investigations show that it should be changed, we will suggest that it be changed.

The species of algae differ in different parts of the country, and what could be a problem species in one place might not be a problem species in another, and you should have differences in their phosphorus requirements.

There are some algae that do not like phosphorus. They don't grow unless it is very, very low.

Nitrates, of course, differ too. You cannot get one answer that is going to apply to this whole problem. We are never going to get it, and if you try to wait for it, we are going to miss the boat.

MR. OEMING: Then are you satisfied with an objective at the present time of .03 or .05?

DR. TARZWELL: Well, let me put it this way: I think .03 is probably a fairly good average. It is something to shoot for, and if you find that there are certain algae that are giving you trouble and the level should be reduced in order to control them, why, you have to reduce it further.

MR. OEMING: I have another question that I have been trying to get an answer to from many biologists, and I think probably you can answer it.

What would be the condition of Lake Erie at its terminal point? We are talking about a dying organism here of some kind. What do you visualize would be the condition of Lake Erie -- not of the small lakes in Wisconsin or Michigan, but Lake Erie as a body of water at its terminal point?

DR. TARZWELL: What do you mean by "terminal point"?

MR. OEMING: When you would say it is dead.

DR. TARZWELL: Well, Lake Erie is not dead until it is filled in.

MR. OEMING: That is right. Now, does this mean that Lake Erie will ultimately reach this point where it will fill in if something isn't done?

DR. TARZWELL: Well, as you know, nothing on this earth is permanent. We have mountain ranges where beaches used to be, and lakes have filled up in the past, and in geological time probably all these lakes will be filled in unless there is some period of glaciation to scoop them out or there is a subsidence of the area.

But I don't think that this is the question we are discussing. The question is not one of dying or completely filling, it concerns a change in environmental conditions which interferes with or destroys our desired uses, and this can happen long, long before death or the development of dystrophication. Our objective and main interest is to try and put this change back on a geological time-table instead of the greatly increased rate of change which has come about through man's activities, chiefly the addition of tremendous amounts of nutrients.

If we control municipal wastes enriched soil will still come in, but it represents only a fraction of the amounts now being added. Out at Lake Washington their first action was an effort to control the sewage wastes in order to make environmental conditions less favorable for blue-green algae. This, I think, is the thing you are shooting for. You are not just going to say, "Well, we are going to keep it from dying," are you?

MR. OEMING: I think what I am interested in is what would happen if the situation were unchanged or stabilized. If it were stabilized now, what would be the condition or the situation, say, in fifty years or a hundred years? Can you forecast this? Is the science so exact that we can forecast this?

DR. TARZWELL: No, we cannot forecast it exactly, and there are no crystal balls, but we know from experience or observation on what has occurred in other lakes that with continued enrichment you get continued blooms.

You have seen some lakes, I think, if you have been in Iowa and some other places, that are almost like pea soup.

If this enrichment goes on and it is accelerated, and it will be with the increase in our population, and if we don't do something about it, we can put it in this pea-soup condition.

MR. OEMING: Thank you. That is all.

MR. STEIN: Are there any further questions?

Mr. Eagle?

MR. EAGLE: I am George Eagle from Ohio.

Dr. Tarzwell, did you mean for your remarks about the increased algal growths in Lake Erie to apply to the whole lake, the entire lake?

DR. TARZWELL: There have been some increases in the entire lake, but the increase has been most noticeable near the places where the organic material enters the lake. It has been most noticeable in the western part of the lake, which is shallower.

You see, one reason ponds are usually richer than lakes is they are shallower and there is continual circulation of the water by wind action. This continually brings the nutrients up from the bottom.

In the western end, you get continual recirculation of nutrients, and you do get higher populations in the western end.

In deeper portions of the lake, of course, you have a greater reserve of DO and you do not get the same conditions that you do in the western end.

MR. EAGLE: You have more oxygen in the deeper part of the lake?

DR. TARZWELL: Well, yes. There is more of a reserve to draw upon. You have more water in the hypolimnion.

MR. EAGLE: Well, this is not borne out in your report. It says the deeper part of the lake is where you have the depletion of oxygen.

DR. TARZWELL: This is in the immediate area of the bottom. In deep lakes which do not circulate in summer and which have considerable organic matter added to them there is a depletion of oxygen in the bottom layers. However, in Lake Erie there is a greater reserve of DO in the deeper portion.

MR. EAGLE: Has there been an increase in the eastern part of the lake?

DR. TARZWELL: Well, I will leave that to the people who are going to come after me and present the detailed report.

MR. EAGLE: Thank you.

MR. STEIN: Are there any further comments or questions of Dr. Tarzwell.

(No response.)

MR. STEIN: Thank you very much for an excellent presentation. We certainly learned quite a bit from it.

As you can see, Mr. Oeming, he is one expert who gives you a question and answer with a minimum amount of qualifications. We are fortunate enough indeed to have Dr. Tarzwell.

At this point, we will recess for ten minutes and then reconvene.

(After recess.)

MR. STEIN: May we reconvene?

Dr. Tarzwell, I believe Mr. Oeming wanted a further clarification on a point. Could you come back, sir?

MR. OEMING: Dr. Tarzwell, would you clarify this question for me, on whether you are talking about soluble phosphorus or total phosphorus in a system when you refer to .03 to .05 as being a desirable goal?

DR. TARZWELL: I didn't necessarily say these levels were desirable. Don't put words in my mouth. I believe Mr. Cook has expressed these levels as total phosphorus. However, time of year is important and, as I said, in our studies in the laboratory we found that we had to starve the algae in order to find the minimum amount that was needed for growth, and that it differed with the different species.

The figures that I had given on our laboratory studies, which are entirely apart from what Mr. Cook is going to give, were soluble phosphorus. However, they were before they had stored it.

When you have phosphorus in water, algae will take it up very rapidly; and if the supply is great enough after the demands are satisfied, soluble phosphorus is still present, growth continues at a rapid rate, other conditions being favorable, and you can get blooms. This is a question upon which we do not have enough data on as yet to give you a hard and fast answer.

For instance, some years ago Dr. Wiebe carried on a study in Norris Lake. He found that in the upper part of the lake there was free soluble phosphorus in the water. However, by the time the water mass had moved halfway down the lake, it was all taken up and there was none in the water, but the algae did continue to grow.

Now, you are going to get a lot of different figures, according to who does the work, what species they use, the methods they use, the season, turnover, and the sequence in timing on the tests.

As I understand it, in the figures that Mr. Cook has given, he is suggesting .03 ppm, and this is as PO_4.

MR. OEMING: That is soluble phosphorus?

DR. TARZWELL: Yes, but, you see, you have to think about time on this. At one time you might have that amount and then another time you might not find nearly that much, whereas in the fall when you had a frost and a sudden cold spell or the algae died off, you might get a much greater amount when you have fewer live algae in the water.

These seasonal changes and growth cycles are the things that make it so difficult to come to something hard and fast that is going to apply all the time.

MR. OEMING: I see. Thank you.

MR. STEIN: Are there any further questions?

Mr. Poole?

MR. POOLE: I want to see if I understood you correctly, Dr. Tarzwell. I think I got it more by inference than actually what you said, but you referred to the fact that we were approaching anaerobic conditions in certain areas of Lake Erie, and then I assumed you were saying that if we did reach an anaerobic condition in the bottom and decomposition set in, that there would be a release then of phosphorus from the bottom deposit.

Am I correct in my assumption?

DR. TARZWELL: Yes. Of course, in the deeper mud you are going to have limited anaerobic conditions even though there is oxygen just a little way above.

You know that oxygen diffuses very slowly in quiet water and you can have some anaerobic conditions in bottom deposits even though there is DO in the water a short distance above, there is usually some anaerobic decomposition, and there is some material being released all the time, naturally.

However, if the DO in the bottom water is used up over extensive areas and for a considerable period and over a considerable area, you will have decomposition taking place there that does release more of these materials.

Another thing that I think people have neglected to take into consideration is the bubbles that form and stir up the bottom materials. Further, as these bubbles pass up through the water, they can take up oxygen and you can get a further depletion of oxygen.

In Lake Washington, there was a slow reduction of dissolved oxygen but when the bottom areas did go anaerobic there was a much more rapid change in conditions and rapid growths of blue-green algae.

MR. POOLE: Thank you.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: Thank you again, Dr. Tarzwell, for your presentation.

(Applause.)

MR. STEIN: Our schedule now calls for us not to keep you here after 12:30 for lunch.

With that in mind, Mr. Poston, will you go on with the Federal presentation?

MR. POSTON: The Federal Government will proceed with Mr. Grover Cook, who, along with Mr. Stephen Megregian, will present the Federal report on water pollution which was prepared after the request for this conference was made by Governor Rhodes.

Mr. Cook.

STATEMENT OF MR. GROVER COOK, CHIEF BIOLOGIST, GREAT LAKES - ILLINOIS RIVER PROJECT, U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, CHICAGO, ILLINOIS

MR. COOK: Mr. Chairman, Conferees, ladies and gentlemen:

For the record, I am Grover Cook, Chief Biologist for the Great Lakes - Illinois River Project, headquarters in Chicago.

For those of you who are following the report, I will depart from the printed text in order to cut down the time involved.

MR. STEIN: Mr. Cook, aren't you also Chief of Enforcement in the Chicago Region?

MR. COOK: Yes.

MR. STEIN: That is what I thought.

MR. POSTON: This is a recently assigned activity for Mr. Cook, and we are looking forward to great things from him in the future.

MR. COOK: Thank you, sir.

On the basis of a written request from

Governor James A. Rhodes of Ohio, dated June 11, 1965, and on the basis of recent reports, surveys, or studies, and in accordance with section 8 of the Federal Water Pollution Act (33 U.S.C. 466 et seq.), the Secretary of the Department of Health, Education, and Welfare called a conference in the matter of pollution of the interstate and Ohio intrastate waters of Lake Erie and its tributaries (Indiana-Michigan-New York-Ohio-Pennsylvania). The conference is to convene first at Cleveland, Ohio, on August 3, 1965, and to reconvene at Buffalo, New York, on August 10, 1965.

This technical report is based on studies made over the past two years under the supervision of the Department of Health, Education, and Welfare. Data obtained from other Federal, State, and local agencies were also used in the report. The report considers the quality characteristics of the waters as they exist today and trends in recent years. It evaluates the effects of waste discharges on water uses, and summarizes the principal problems and needed corrections.

The cooperation of the water resource and public health agencies of the States of Michigan, Indiana, Ohio, Pennsylvania, and New York; county and municipal agencies, and universities throughout the Lake Erie drainage basin, is gratefully acknowledged.

The report is in three parts: Part 1 is concerned with the Lake; Part 2 is concerned with the Michigan, Ohio, and Indiana tributary area; and Part 3 with the Pennsylvania and New York area.

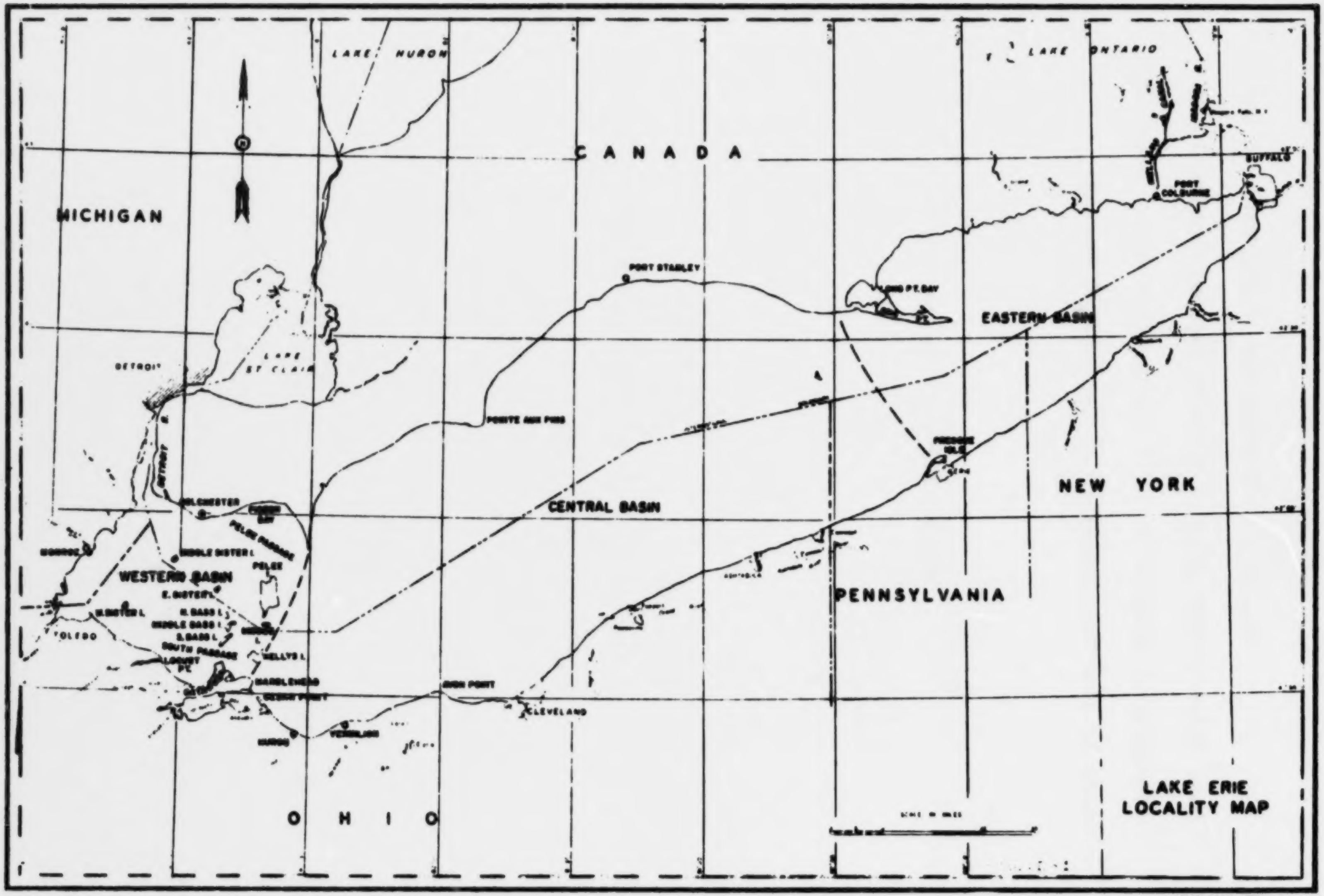
DESCRIPTION OF AREA

General Description

Lake Erie is the oldest, southernmost, and warmest of the Great Lakes. It is by far the shallowest, and the only one with its entire water mass lying above sea level. Lake Erie contains the smallest volume of water; it is the most turbid; it is subject to the widest fluctuations in water level; it has the flattest bottom; and it undergoes the most violent wave activity. In recent years it changed rapidly in chemistry and biology.

Lake Erie (Figure III-1) is approximately 240 miles long with its long axis oriented at about N 70° E. It is more than 50 miles wide near the midpoint of its long axis. The Lake covers an area of 9,940 square miles, and contains a total water volume of approximately 113 cubic miles.

(Figure III-1 is as follows:)


MICHIGAN
CANADA
LAKE HURON
LAKE ONTARIO
LAKE ST. CLAIR
DETROIT
PORT STANLEY
LONG PT. BAY
PORT COLBORNE
BUFFALO
EASTERN BASIN
POINTE AUX PINS
PRESQUE ISLE
NEW YORK
COLCHESTER
PIGEON BAY
PELEE PASSAGE
MONROE
MIDDLE SISTER I.
WESTERN BASIN
PELEE
E. SISTER I.
W. SISTER I.
N. BASS I.
MIDDLE BASS I.
S. BASS I.
SOUTH PASSAGE
KELLYS I.
LOCUST PT.
TOLEDO
MARBLEHEAD
CENTRAL BASIN
PENNSYLVANIA
AVON POINT
CLEVELAND
VERMILION
HURON
OHIO
SCALE IN MILES

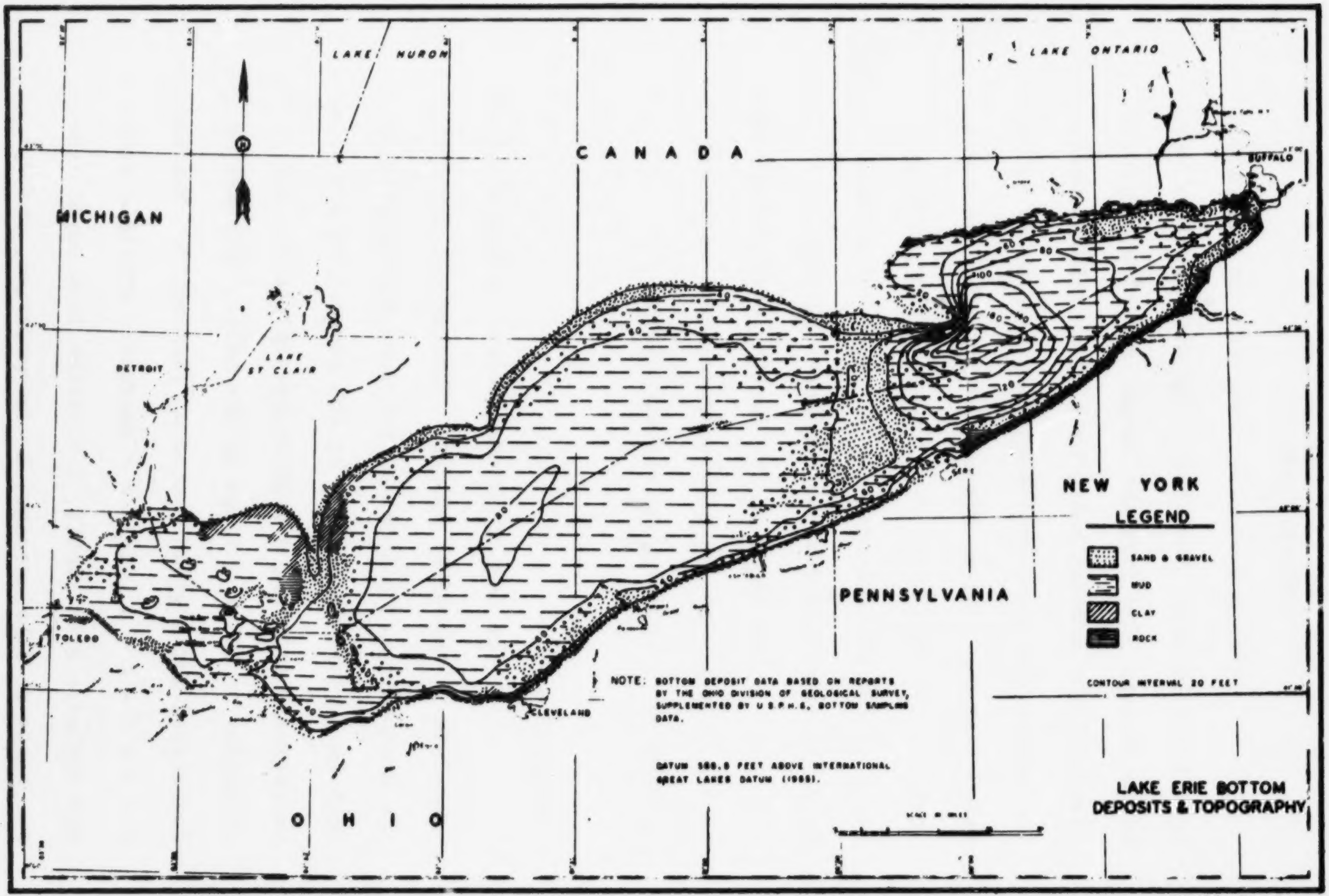
LAKE ERIE LOCALITY MAP

FIGURE III-4

Grover Cook

Figure III-2 shows the topography of the Lake Erie bottom, with a 20-foot contour interval, as interpreted from U. S. Lake Survey charts and soundings made by the Ohio Division of Geological Survey.

(Figure III-2 is as follows:)


LAKE HURON
LAKE ONTARIO
CANADA
MICHIGAN
NEW YORK
PENNSYLVANIA
OHIO
BUFFALO
DETROIT
LAKE ST CLAIR
TOLEDO
CLEVELAND
LEGEND
SAND & GRAVEL
MUD
CLAY
ROCK
CONTOUR INTERVAL 20 FEET
SCALE IN MILES
60
80
100
120
180

NOTE: BOTTOM DEPOSIT DATA BASED ON REPORTS BY THE OHIO DIVISION OF GEOLOGICAL SURVEY, SUPPLEMENTED BY U.S.P.H.S. BOTTOM SAMPLING DATA.

DATUM 568.6 FEET ABOVE INTERNATIONAL GREAT LAKES DATUM (1955).

LAKE ERIE BOTTOM
DEPOSITS & TOPOGRAPHY

FIGURE III - 2

Grover Cook

Topographically, Lake Erie is separated into three basins. The relatively small shallow western basin is separated from the large, somewhat deeper, flat-bottomed central basin by a rocky island chain. The relatively deep, bowl-shaped eastern basin is separated from the central basin by a low, wide sand and gravel ridge near Erie, Pennsylvania. The average depth of the western basin is 24 feet, the central basin 60 feet, and the eastern basin 80 feet.

The water in the western basin is the most turbid. It is less turbid in the central basin and is usually very clear in the eastern basin.

Hydrology

One method of describing the hydrology of Lake Erie is the water budget. This method involves the accounting of all water, incoming and outgoing, such as inflow and outflow by the rivers, supply from underground storage, overwater precipitation, and variation in water storage in the Lake. This can be formulated for a given period of time by the equation: $P + R + I - E = O$, where P = overwater precipitation, R = drainage area runoff, I = inflow from upper lakes, S= change in lake storage, E = evaporation, and O =

outflow from Lake Erie. The supply from underground storage is considered to be a part of runoff, but it is considered negligible as a direct supply to the Lake.

Precipitation and streamflow records made since 1937 provide the basis for calculation of the water budget in this report. Precipitation on the Lake surface is a direct contribution to its water supply and the Lake level is affected immediately. Average annual precipitation over the Lake has been estimated at 34.6 inches.

Surface runoff from the drainage area enters the Lake via the many tributary rivers or by direct runoff from the shore areas. Average annual runoff since 1937 has been estimated at 21,000 cfs, equivalent to 29.1 inches of water over the Lake's surface, and to 35 percent of the overland precipitation.

Nearly 90 percent of the total inflow to Lake Erie comes from the Detroit River, the drainage outlet for Lake Huron. The average annual inflow, as measured by the U. S. Lake Survey near the head of the Detroit River, is 182,000 cfs, equivalent to 251 inches of water on Lake Erie.

The outflow from Lake Erie is through the Niagara River at Buffalo and the Welland Canal diversion at Port Colborne. Combined outflow averages about 202,000 cfs annually, equivalent to 279 inches of water on Lake Erie. Seasonally, both inflow and outflow are generally higher in the early summer and lower in the winter.

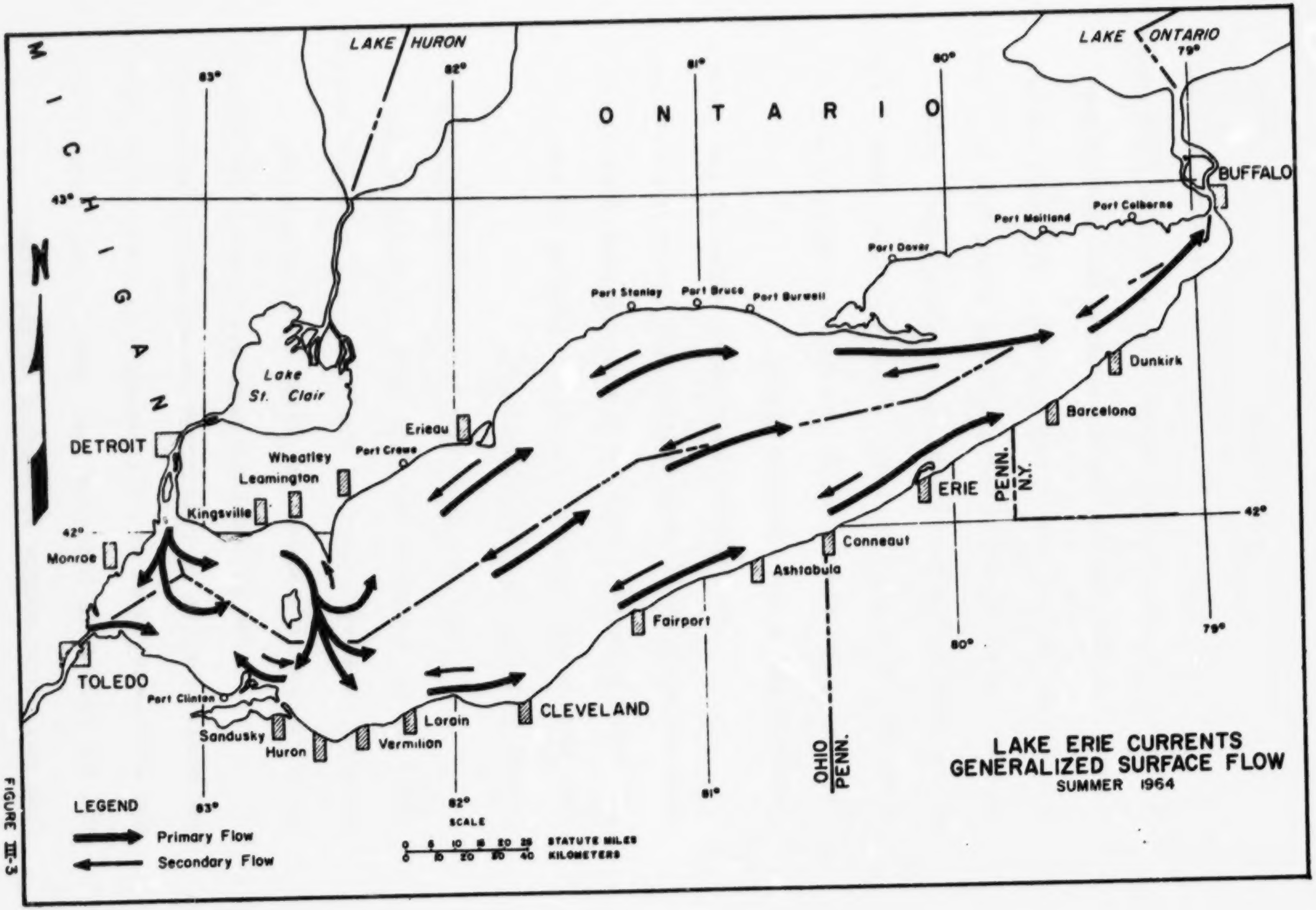
Annual evaporation from the Lake surface averages 33.5 inches. The low evaporation season extends from January through June, and the high evaporation season is from July through December.

The variations of Lake level on an annual basis are small, though on a monthly basis they may be relatively large. The average annual change in Lake storage in the period 1937-1959 has been insignificant and it is therefore unimportant in the computations of an average annual water budget.

Lake Currents

The net movement of water in Lake Erie is from west to east draining into Lake Ontario via Niagara River. Figure III-3 shows the generalized flow pattern within the upper 30 feet.

(Figure III-3 is as follows:)


LAKE HURON
LAKE ONTARIO
MICHIGAN
ONTARIO
83°
82°
81°
80°
79°
43°
42°
BUFFALO
Port Colborne
Port Maitland
Port Dover
Port Stanley
Port Bruce
Port Burwell
Dunkirk
Barcelona
PENN.
N.Y.
ERIE
Conneaut
Ashtabula
Fairport
OHIO
PENN.
CLEVELAND
Lorain
Vermilion
Huron
Sandusky
Port Clinton
TOLEDO
Monroe
DETROIT
Lake St. Clair
Kingsville
Leamington
Wheatley
Port Crewe
Erieau
LEGEND
Primary Flow
Secondary Flow
SCALE
0 5 10 15 20 25 STATUTE MILES
0 10 20 30 40 KILOMETERS

LAKE ERIE CURRENTS
GENERALIZED SURFACE FLOW
SUMMER 1964

FIGURE III-3

Grover Cook

More than 90 percent of the input to Lake Erie is from the Detroit River. Most of this flow comes down the center of the River, fanning out continuing far southward into the western basin. The flow along the west side of the river continues along the Michigan shore to mix with the Maumee River discharge. This flow then continues eastward along the Ohio shore. The flow along the east side of the Detroit River moves eastward along the Canadian shore.

The western basin water mixes in the island area and most of it then drains into the central basin via Pelee Passage. Studies show a dominant flow toward the west in the southern channels creating an essentially rotary movement in the island area.

The drainage from Pelee Passage appears to reach as far south as the Ohio shore at least at the surface. However, much of the flow turns eastward before reaching that far south, as shown in Figure III-3.

The predominant eastward flow in the central and eastern basin is reinforced by prevailing winds from the southwest, however, wind studies for a 10-year period for Lake Erie indicate that the reversed pattern of flow may occur nearly 25 percent of the time.

Discharges from tributary streams along the

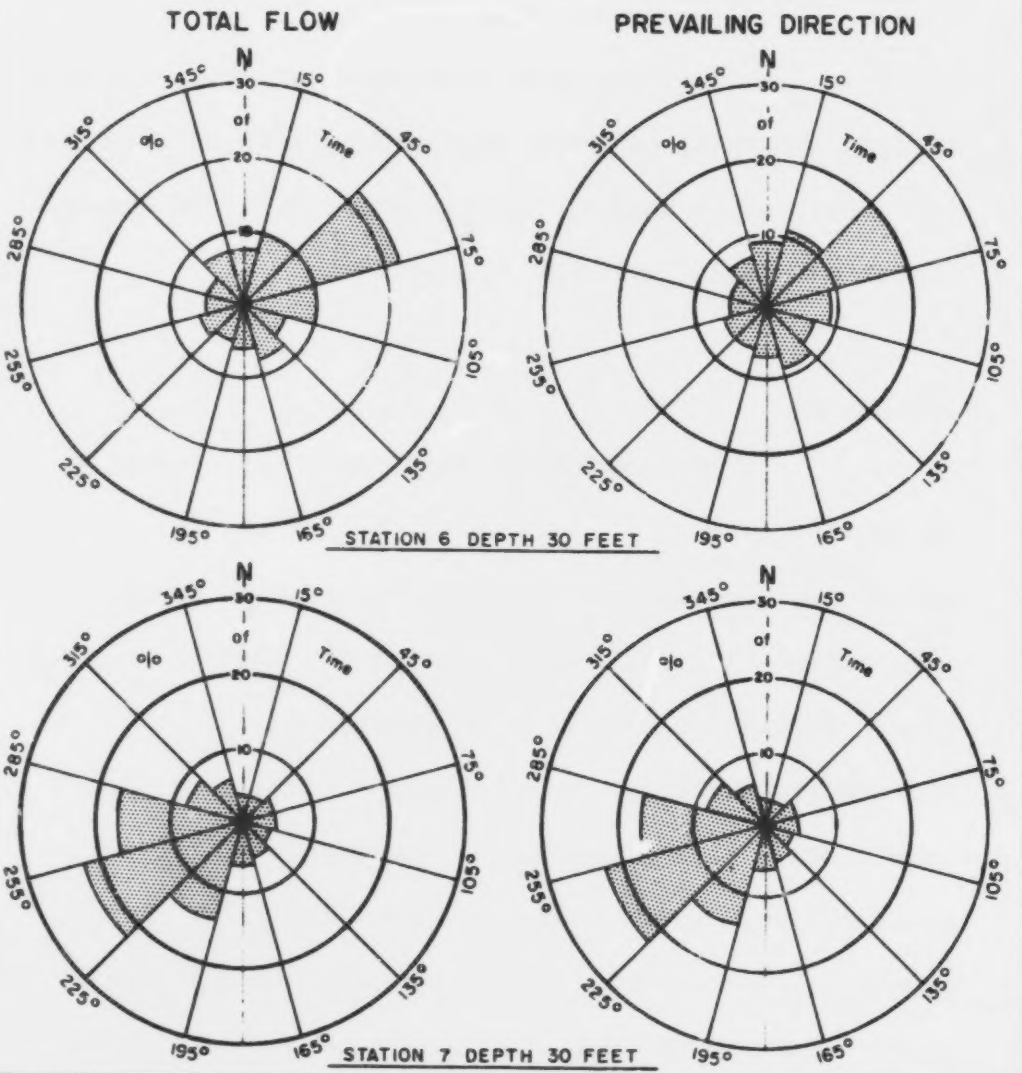
Grover Cook

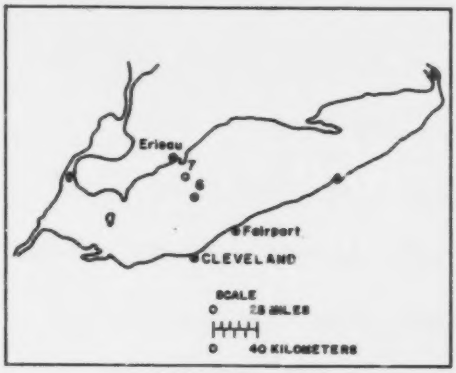
south shore such as the Huron, Vermilion, Black and Cuyahoga Rivers, and other streams to the east in Ohio, Pennsylvania, and New York, tend to stay along the south shore and move normally eastward with an alternate, but smaller secondary flow to the west. General dispersal of the flows from the south shore streams with the deeper off-shore waters is limited.

The discharge of wastes and the tributary streams along the south shore of the lake will increasingly contribute to the pollution of beaches and other water uses as it moves along the shore, both from Ohio waters into Pennsylvania and to a lesser extent from Pennsylvania to Ohio. This along shore flow will also apply to the movement of tributary streams and wastes from Pennsylvania to New York and to a lesser degree from New York to Pennsylvania.

Deep water or mid-lake circulation is complex in the central and eastern basins being controlled to a great degree by the wind. The wind induces surface flow in its general direction accompanied by an opposing subsurface flow into the wind. Since south-west winds prevail, the surface flow is dominantly toward the east and the subsurface flow is dominantly toward the west over most of the central and eastern basins. A wide band along the Canadian shore, as wide as about 1/3 of the lake's width, moves predominantly eastward from top to bottom. These phenomena are shown in Figure III-4 at stations 6 and 7. Figure III-4 shows the frequency of direction of flow and total flow at a depth of 30 feet for the summer of 1964. The net movement is from east to west at station 6, at station 7 the net flow is toward the east.

(Figure III-4 is as follows:)




Erieau
7
6
Fairport
CLEVELAND
SCALE
0 25 MILES
0 40 KILOMETERS

LOCATION MAP

North at N

NOTE:
Direction is from the sector shaded, toward the center.

LAKE ERIE CURRENTS
SUMMER 1964

FIGURE III-4

Grover Cook

It is apparent from these studies that discharges occurring anywhere along the shores of Lake Erie can affect water quality in Lake Erie, with the dominant effect occurring from west to east.

Population

The 1960 census shows that approximately 10 million persons live in the U. S. portion and 1.2 million persons live in the Canadian portion of the Lake Erie basin. This is almost three times the 1910 population. Population of the U. S. portion of the basin is expected to double within the next 50 years. Although this overall rate of growth is comparable to the estimated national growth rate, past and estimated future growth rates show great differences within the watershed. Between 1940 and 1960 many economic subregions, and the counties which comprise them, have shown rapid growth rates. Almost 80 percent of the population is evenly divided between Michigan and Ohio.

Counties which have shown the most rapid growth rates during the 1950-1960 decade include Macomb and Oakland counties in Michigan, and Lake and Geauga counties in Ohio. In terms of actual numbers, however, the largest increases were in Oakland, Macomb, and

Wayne counties in Michigan; Allen county in Indiana; Erie county in New York; and Cuyahoga, Summit, Lorain, and Lucas counties in Ohio. These nine counties of the total of 45 in the basin accounted for 50 percent of the 1950-1960 increase in population. Present indications are that these large metropolitan counties will account for an even greater share of the total population of the basin in the future.

Economics

Industrial activity as measured by value added by manufacture, although occurring in substantial volume in most counties, is for the most part highly concentrated in a few metropolitan areas. The leading counties in 1958 were: Wayne, Michigan; Cuyahoga, Ohio; Erie, New York; Summitt, Ohio; Lucas, Ohio; and Oakland and Macomb, in Michigan, in the order listed. These seven counties in 1958 accounted for 75 percent of the total value added by manufacture in the entire watershed. Manufacturing is even more concentrated in a small group of counties than is the population. Whereas the total population of the watershed will more than double by the year 2020, industrial activity may increase six or seven-fold. Unless industries show a reduction in net water use per unit of production, industrial water requirements and possible waste returns will account for a much larger percentage of the total water used and waste returns in future decades.

The dominant industries in the largest metropolitan areas in this highly industrialized region are as follows:

Detroit - Automotive and related industry, steel, chemicals, pulp and paper, petroleum refining, and rubber.

Toledo - Automotive, glass, petroleum refining, and steel.

Cleveland - Steel, steel fabricating, automotive, and chemical.

Erie - Pulp and paper, and general manufacturing.

Buffalo - Steel, chemical, automotive, pulp and paper, Portland cement, flour milling, and electrical equipment.

Importance of Lake Erie as a Water Resource

Municipal Water Supply

Lake Erie is used as a source of municipal water supply by 27 waterworks serving many municipalities.

These municipal systems serve more than 3.2 million people, and a number of industrial firms, with some 619 million gallons a day.

A summary by states showing the number of municipalities, population served, and estimated water usage is given below. The Ohio portion of the basin accounts for about two thirds of the use.

Municipal Water Supply

Lake Erie

State	Number of Waterworks	Estimated Population Served	Estimated Water Usage mgd
Ohio	16	2,239,000	409
Michigan	2	23,000	3
Pennsylvania	1	160,000	44
New York	8	835,000	163
	27	3,257,000	619

Industrial Water Supply

Industries use an estimated 4.7 billion gallons of water daily from Lake Erie. As the tabulation below shows, power production (cooling water) accounts for some 80 percent of the industrial withdrawals. Water used for other industrial cooling accounts for approximately 15 percent. Approximately 100 mgd is withdrawn directly by industries as process water. In addition, an unknown amount of industrial process water is obtained from municipal supplies.

Industrial Water Supply

Lake Erie

State	Total Withdrawal (mgd)	Amount Used for Power (mgd)	Amount Used for Cooling (mgd)
Ohio	2,210	1,920	270
Michigan	337	190	2
Pennsylvania	170	140	20
New York	2,020	1,600	350
	4,737	3,850	642

Lake Erie Commerce

Lake Erie is fourth in size of the five Great Lakes, but its total freight tonnage of 107.5 million tons was second only to that of Lake Huron in 1962.

The domestic shipping in 1962 on Lake Erie was 74.7 million tons, or 70 percent of the total tonnage. Domestic shipping included all commercial movements between points in the continental United States. The foreign shipping (93 percent Canadian) was 32.8 million tons, 30 percent of the total. In ton-mileage, Lake Erie accounted for 12.6 billion ton-miles.

Lake Erie has eleven major U. S. ports: Toledo, Detroit, Cleveland, Buffalo, Ashtabula, Lorain, Sandusky, Conneaut, Fairport, Erie, and Huron. During the period from 1953 to 1962, eight of these ports have shown a decline in total tonnage. In 1964, the Corps of Engineers dredged about 3.3 million cubic yards from Lake Erie ports at a cost of about $1.2 million for routine maintenance of the navigation channels.

Recreation

Lake Erie does not have big, wide sand beaches. Good beaches, however, are at Catawba Island; Cedar Point at Sandusky; and Erie, Pennsylvania. These highly developed recreational areas attract thousands of people each year. The beaches in most other areas are relatively narrow. Some cities, such as Cleveland, have provided man-made beaches to serve the people in the area.

Lake Erie is used extensively for other recreational purposes such as fishing and boating. There are many boat launching ramps along the lakeshore, which serve people from a wide area. There are a large number of boats that are trailered to various sites each weekend, many from outside the area. Due to this fact, it is difficult to determine exactly how many boats are actually using the Lake. However, a fair estimate can be made by totaling the boats registered in the counties near the Lake. This is the basis for the second column in the tabulation below.

State	Total State Boat Registration (1964)	Estimated Number Using Lake Erie
Ohio	142,922	73,000
Michigan	362,112	79,000
Pennsylvania	78,359	6,000
New York	335,000*	34,000
	918,393	192,000

*Estimate made by State of New York, Department of Conservation.

Fish

Commercial fishing has been practiced in Lake Erie for more than a century and a half. It has always produced more fish and a greater variety of fish than the other Great Lakes, but the species composition has varied greatly, and the annual harvest has diminished.

Lake herring practically vanished around 1890, and whitefish have declined greatly since about 1920. Lake trout, which never reached great numbers, are practically nonexistent today. The blue pike, a highly desirable species, declined from a peak annual U. S. catch of 20 million pounds in 1936 to a meager 7,400 pounds in 1960. Sauger also declined sharply from a U. S. catch of about 6 million pounds in 1916 to almost none in 1960.

The importance of sport fishing in Lake Erie is reflected in the numbers of fishermen and in the annual harvest of sport fishes. In the counties bordering Lake Erie, more than one-half million fishing licenses were issued in 1964. Presumably, a good many of those people fish in Lake Erie. According to a 1964 report by the Ohio Department of Natural Resources, boat anglers in 1960 harvested 1,300,000 pounds of fish. During that year, the Ohio commercial catch was 1,290,000 pounds. Species that predominated the sport harvest were yellow perch, sheepshead, white bass, small-mouth bass, channel catfish, and walleyes. The highest intensity of sport fishing was in the island area. Fishing pressure is also heavy in the Michigan and Pennsylvania waters.

Grover Cook

DEGRADATION OF LAKE ERIE

Lake Enrichment

Eutrophication means enrichment of waters through either man-created or natural means. Natural enrichment produces a rate of lake aging that may be manifested only on the clock of geologic time. Additional fertilization will accelerate the rate of lake aging, making changes in water quality noticeable within a decade or even less. For example, growing cities and expanding industries are pouring nutrients into the nationa's waterways at an ever-increasing rate, and aquatic weed and algal nuisances are occurring in areas where they did not exist before.

The scope of accelerated eutrophication or water enrichment is broad and the ramifications are many. The most perceptible characteristics to the layman include nuisance growths of small suspended plants or algal scums, developing areas of rooted water plants, and odors associated with decaying dead vegetation and possibly fish. More subtle changes can be found by the investigator as indicated by decreased light penetration; decreased dissolved oxygen in deeper waters; increased nitrogen and phosphorus concentrations especially in the deeper waters; significant changes in the algal population, and in the kinds and numbers of bottom dwelling organisms, and increased rooted aquatic weed beds.

There are many elements that are essential to life processes. Among these are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, and several trace minerals. They are all present in sewage. Nitrogen and phosphorus is partially removed by a sewage treatment plant, but the percentage of removal depends on plant design and efficiency of operation. Nitrogen is in good supply from natural sources (80% of the air we breathe is nitrogen), but phosphorus is not plentiful The density of algae growth is usually governed then by the concentration of phosphorus. If phosphates are reduced, algae growths are correspondingly less. Phosphorus, a constituent of domestic sewage and certain industrial wastes, promotes algae growths and is thus a serious pollutant that must be controlled.

It is well documented that many lakes throughout the country have been fertile reservoirs algal development for many years and have been label eutrophic. Included among these are Lake Zoar in Cecticut, Lake Sebasticook in Maine, the Madison lakes Wisconsin, Lake Erie, the Detroit lakes in Minnesot

Green Lake and Lake Washington in Washington, and Klamath Lake in Oregon. Of these, Lake Erie is the largest.

When the concentrations of inorganic nitrogen and soluble phosphate exceed 0.3 mg/l and 0.03 mg/l, respectively, prior to the algal growing season and when other growth conditions such as light, temperature, and turbulence are favorable, algal blooms have been found o develop. Those algae that occur usually in small num- rs in infertile lakes become supplanted by larger popu- ions of more troublesome kinds.

As nutrient concentrations increase, the n ers of algal cells increase. Nuisance conditions su as surface scums and algal-littered beaches occur. Th ater may become foul-smelling. Filter-clogging pro ms may occur at municipal water supplies. Fila- men s algae, especially *Cladophora*, grow profusely on alm any suitable subsurface. They, too, cause nuisance cond ons when they break loose and wash ashore at bath- ing hes to form windrows of stinking vegetation. Growt of filamentous algae and slimes hamper commercial fishi by adhering to nets, and interfere with municipal and i trial water supplies by clogging intake screens.

At this stage of eutrophication other changes are oc ing in the lake. The bottom is changed by

Grover Cook

sedimentation of organic material; this habitat is changed from one suitable for mayfly nymphs, scuds and other small organisms favored as food by desirable fish to one where only sludgeworms and bloodworms can exist. Fish populations are changed to the coarser species because the habitat is more favorable to them.

Nutrient concentrations in Lake Erie indicate that soluble phosphate values in the western basin consistently exceeded the stated critical value during studies in 1963 and 1964, with average concentrations ranging from 0.05 to 0.15 mg/l phosphate (PO_4). The central and eastern basins now have phosphate concentrations at the critical threshold value and any increase in present levels will produce a corresponding increase in algal populations.

Water clarity as demonstrated by Secchi disc readings indicates that visibility of the white and black disc extends through 4 feet in the western basin, and through 13 feet in both the central and eastern basins. Because this test measures relative turbidity conditions by a combination of algae and other suspended material, it reflects undesirable changes in the western basin.

The biology of the western Lake Erie basin

Grover Cook

has changed drastically during the past 35 years, and especially the past 15. In the Bass Island area, samples collected in September 1964, showed suspended algal populations of 3,500 organisms per milliliter (about 3.5 million per quart) compared to a maximum 1,000 per milliliter found in a study conducted between 1938 and 1942. Species composition has also changed from one predominantly of diatoms to one presently dominated by blue-green algae that are associated closely with enriched waters.

Long-term increases in suspended algal populations are also apparent from data published for the area adjacent to Cleveland in the central basin of Lake Erie. Annual averages have increased from 200 to 400 cells per milliliter between 1920 and 1930 to 1500 to 2300 cells at the present time. Also, there have been significant changes in dominant organisms with blue-green algal forms becoming increasingly present even in this area.

Although historical data are not available for the suspended algae of the eastern basin, PHS studies in 1963 and 1964 revealed that the kinds and numbers are similar to those that occurred in the central basin.

The filamentous green alga Cladophora is encouraged by enriched waters to grow on any suitable attachment site. When it matures, it characteristically breaks loose, floats to the water surface, and creates an odorous nuisance when deposited on beaches by wind and waves. An estimated 340 miles of Lake Erie shoreline has a subsurface suitable for Cladophora growth. Nuisance conditions have become so severe that restricted swimming and sunbathing have occurred in the island area and at the beaches in the eastern basin, especially east of Erie, Pennsylvania and near Dunkirk, New York.

A survey of Lake Erie bathing beaches was made in 1964 to determine their present use. As the tabulation below shows, 21 of the 32 beaches contacted reported that they were open.

BATHING BEACHES

LAKE ERIE

Area	Status - 1964
21	Open
6	Open-closed intermittently
3	Closed
1	Open but posted unsafe
1	Open - high coliform counts observed

Grover Cook

At six beaches, it has been found necessary to restrict swimming for short periods during and following rains and high winds owing to an increase in microbiological pollution. Beaches of this type are classified "open intermittently."

The three beaches that are closed are at Toledo and two areas in New York. The beach at Sterling State Park, Michigan, was reported open but posted as unsafe for bathing.

The four groups of bottom-dwelling animals that occur abundantly in Lake Erie include sludgeworms, bloodworms, and fingernail clams, all of which are found in a lake bed covered by decaying organic ooze; and scuds which prefer a relatively clean lake bottom. Of the four groups, scuds are preferred as food by the more desirable fish species. Although all of these organisms were found in all three basins of Lake Erie there was a difference in the relative abundance of each.

In the western basin, sludgeworms and bloodworms were predominant in three large areas. One area extended from the Detroit River mouth southward for more than ten miles. Another fan-shaped area extended from the mouth of the Maumee River for a distance of ten miles. The third area extended about 4 miles lakeward from the mouth of the River Raisin.

Sludgeworms, bloodworms, and fingernail clams predominated in the bottom populations in almost the entire western two-thirds of the central basin. In the eastern third of the central basin, as in the eastern basin, scuds were the predominant animals.

These present conditions are in sharp contrast to the kinds of bottom-dwelling organisms that occurred in the western basin in past years. Prior to 1953 burrowing mayfly nymphs were by far the predominant bottom organisms. In September 1953 the western basin became thermally stratified and dissolved oxygen was depleted in the deeper waters. Great numbers of mayflies were killed. Although some areas were repopulated by mayflies in 1954 the overall distribution of these important fish food organisms declined year by year, and by 1959 only a few organisms could be found. During this same period the caddisfly, another desirable fish food organism, virtually disappeared from the deeper waters surrounding the islands. In both instances sludgeworms and bloodworms have supplanted the mayflies and caddisflies as the predominant bottom-dwelling animals. Restoration of mayfly and caddisfly population will not be possible as long as period deleterious dissolved oxygen conditions occur. The above biological evidence indicates a general degradation of conditions in Lake Erie from east to west, reflecting the major influence of the large sources of waste at the west end of the Lake.

Dissolved Oxygen Deficit in the Bottom Waters

Low dissolved oxygen concentrations were detected in the bottom waters of the central basin as early as August 1929 when DO values of 4.4 and 4.8 mg/l were recorded at 2 stations in the central basin. A low value of 0.8 mg/l was measured at one station near Marblehead, Ohio, in August 1930.

Low DO values from 1948 through 1951 of 2 to 4 mg/l were recorded and in September 1959 the DO was found to be less than 3 mg/l in a large area of the central basin. A survey in August, 1960 revealed a similarly large area where the DO was less than 3 mg/l. One zero DO was recorded in August 1959 near the south shore.

In August 1964, an area of about the same magnitude was found where the DO concentrations were even lower (Figure IV-1). Most of the affected area

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had DO values of 2 mg/l or less. This area was about 2,600 square miles, or about 25 per cent of the entire Lake.

(Figure IV-1 is as follows:)

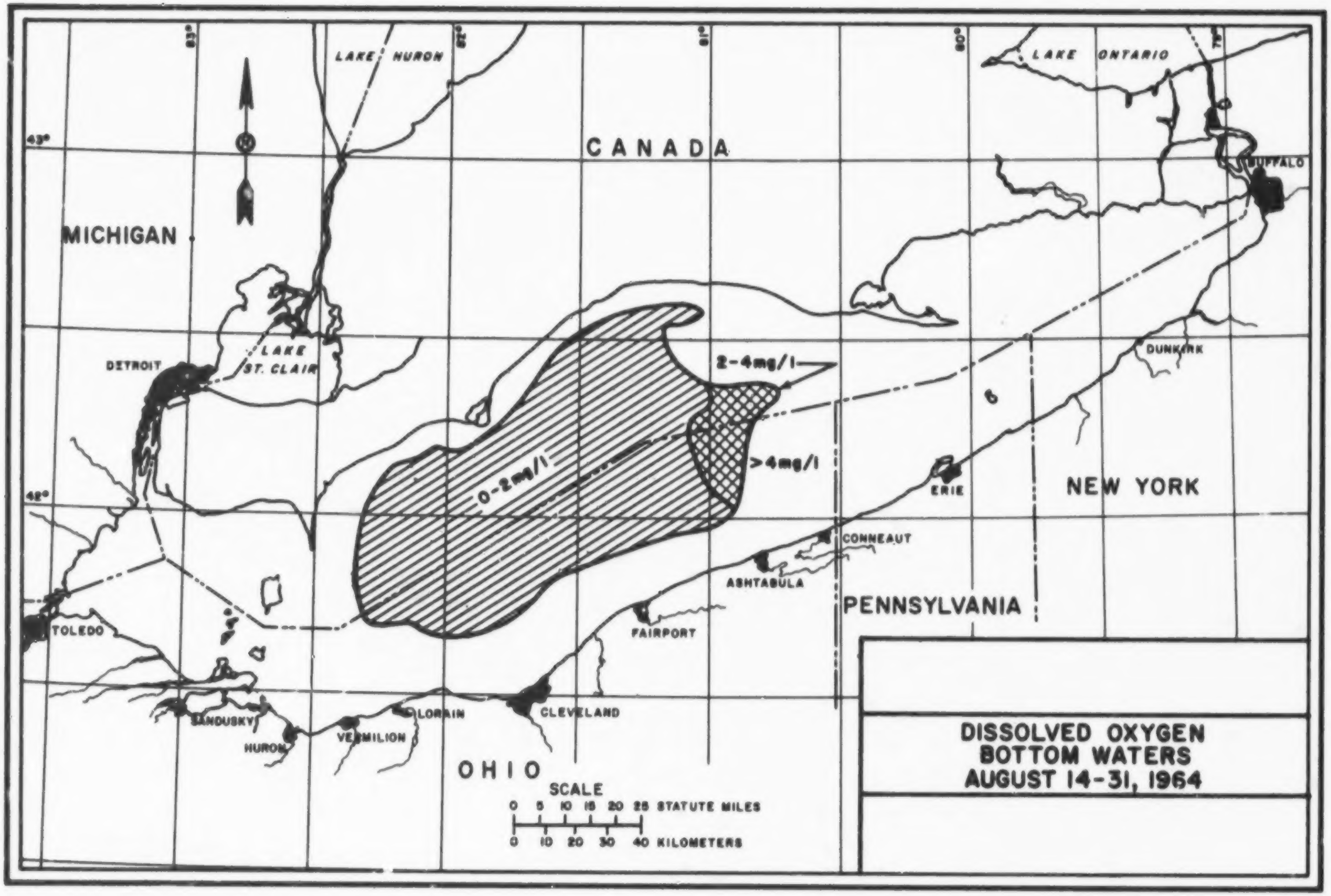
DISSOLVED OXYGEN
BOTTOM WATERS
AUGUST 14-31, 1964
CANADA
MICHIGAN
NEW YORK
PENNSYLVANIA
OHIO
LAKE HURON
LAKE ONTARIO
LAKE ST. CLAIR
DETROIT
TOLEDO
SANDUSKY
HURON
VERMILION
LORAIN
CLEVELAND
FAIRPORT
ASHTABULA
CONNEAUT
ERIE
DUNKIRK
BUFFALO
0-2mg/l
2-4mg/l
>4mg/l
43°
42°
83°
82°
81°
80°
79°
SCALE
0 5 10 15 20 25 STATUTE MILES
0 10 20 30 40 KILOMETERS

Figure IV-1

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In summary, dissolved oxygen values in the bottom waters of the central basin of Lake Erie appear to have decreased during the past 35 years from about 5 mg/l to less than 2 mg/l, with many parts near zero.

This DO deficit is caused largely by lake enrichment. When this is coupled with a physical phenomenon called thermal stratification, the mechanism is established through which oxygen is consumed in the bottom waters. As explained earlier, the lake is enriched by the introduction of such materials as nitrogen and phosphorus that encourage plant growth. Thermal stratification occurs when the upper layer of lake water becomes one temperature, a lower layer of water becomes a different temperature, and a third layer of water called the thermocline is sandwiched between them. The thermocline is the layer where a sharp temperature differential exists.

During summer stratification, the upper water layer is as much as 16° C higher than the bottom layer. Almost all lakes stratify thermally, but dissolved oxygen deficits occur only in those lakes where large amounts of oxygen-consuming materials and nutrients have been introduced. These materials may be introduced directly as sewage or certain industrial wastes, or indirectly by nutrients that accelerate algal growth. Suspended organic materials are scattered over a wide area by winds and lake currents, settle to the bottom, and exert an oxygen demand during decay. The crop of suspended algae that grow in great numbers in a fertile lake is ever changing. Cells die off and settle slowly to the bottom. During their descent, they are attacked by decay organisms and exert an oxygen demand. Thus, in a fertile lake, oxygen is being removed by the bottom muds and by the suspended organic matter in the water above. Lake Erie is susceptible to damage from these happenings, especially in its central basin.

The western basin does not become stratified except during 6 to 7 day periods of calm because it is so shallow that wind-induced turbulence creates thorough mixing from surface to bottom.

Both the central and eastern basins do become stratified, usually from June to October. A serious dissolved oxygen deficit does not develop in the eastern basin because it is much deeper than the central basin. Tht thermocline, or middle layer of water, lowers in the central basin as stratification becomes well established until it is about 50 feet below the surface. At this time, the lower layer of water in the central basin becomes thin, on the order of 8 to 10 feet thick. At the same time, the eastern basin, which is about 150 feet deep, may have a bottom layer 100 feet thick.

The central basin is adjacent to the western basin where there are large inputs of wastes and where the heaviest growths of suspended algae occur. The overall easterly movement of water may carry some of this material to the quieter waters of the central basin where it settles to the bottom.

Changes in the Fishery

Dramatic changes have occurred in the Lake Erie fishery. Although Lake Erie is still the most productive of all of the Great Lakes, the quality of the catch is low. The only high quality fish still abundant is the perch. Blue pike have disappeared, and herring and whitefish are scarce. The Michigan Conservation Department, in a statement presented at the Detroit River-Lake Erie Water Pollution Conference on June 17, 1965, summed up the Lake Erie fishery situation as follows:

> "The evidence is strong that the deterioration of fish resources in these waters has come about principally because of the

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> environmental changes resulting from pollution. These changes are complex and subtle, and have affected fish life in many ways. Perhaps the most important change is rapid eutrophic aging stimulated by nitrogen compounds and phosphates found in organic wastes. Nutritive enrichment provided by these wastes leads to oxygen depletion, temperature increases, turbidity, and interruption of the biological food chain. In addition, some chemical and industrial waste toxicants directly harm fish."

and they concluded:

> "The fisheries....can be saved only by an all-out effort to restore water quality to standards favorable to desirable fish."

WASTE INPUTS TO LAKE ERIE

Introduction

Municipal sewage and industrial wastes are the principal pollutional materials discharged continuously into the waters of Lake Erie. These waste sources, along with other sources such as land runoff; combined sewer overflow, and wastes from lake vessels; barge

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tows and pleasure crafts, all add to the pollution of the Lake by direct discharge or by increasing the tributary loadings of rivers draining into the Lake.

Municipal Wastes

Approximately 10 million people inhabit communities throughout the Lake Erie basin. These communities discharge their wastes directly into Lake Erie or into rivers tributary to it. Table V-1 shows the approximate unsewered and sewered populations discharging into the various rivers from each state bordering the Lake. The table also shows the degree of treatment, primary and/or secondary, received by the sewered population. Population equivalents are given and include the sewered industrial load as well as the municipal load.

(Table V-1 is as follows:)

TABLE V-1
LAKE ERIE MUNICIPAL WASTE TREATMENT FACILITIES

River Subbasin	Drainage Area (sq. miles)	Estimated Population Equivalent				
		Total	Unsewered		Sewered	
			1	2	Primary	Secondary
OHIO						
Maumee River	6586.3*					
Auglaize River	2448.2*	190,995	7,240	16,600	---	167,155
Lower Maumee River		623,910	5,035	5,815	3,660	609,400
St. Joseph River	1060.4*	11,780	---	3,330	8,450	---
St. Marys River	816.7*	22,560	---	2,600	440	19,520
Tiffin River	804.5*	44,915	2,395	2,045	---	40,475
Upper Maumee River		13,735	1,465	1,020	9,650	1,600
Totals for Maumee River		907,895	16,135	31,410	22,200	838,150

1 Unsewered, presently under state order to provide waste collection and treatment facilities
2 Remaining unsewered population

* Drainage area for Maumee River includes 4,856.2 sq. miles in Ohio, 1,260.0 sq. miles in Indiana, 470.1 sq. miles in Michigan
Drainage area for Auglaize River includes 2,341.6 sq. miles in Ohio, 106.6 sq. miles in Indiana
Drainage area for St. Joseph River includes 238.0 sq. miles in Ohio, 603.2 sq. miles in Indiana, 219.2 sq. miles in Michigan
Drainage area for St. Marys River includes 457.7 sq. miles in Ohio, 359.0 sq. miles in Indiana
Drainage area for Tiffin River includes 553.5 sq. miles in Ohio, 251.0 sq. miles in Michigan

TABLE V-1 "Continued"
LAKE ERIE MUNICIPAL WASTE TREATMENT FACILITIES

River Subbasin	Drainage Area (sq. miles)	Total	Estimated Population Equivalent			
			Unsewered		Sewered	
			1	2	Primary	Secondary
Ward Canal		450	---	450	---	---
Halfway Creek	18.81	5,000	---	5,000	---	---
Ottawa River	178.51	10,525	---	1,325	---	9,200
Cedar Creek	49.91	3,150	---	950	2,200	---
Crane Creek	54.04	1,565	---	1,565	---	---
Turtle Creek	28.66	665	---	665	---	---
Toussaint Creek	142.29	4,610	---	2,325	---	2,285
Portage River	587.2	75,270	4,905	9,715	4,075	56,575
Muddy Creek	105.59	1,210	---	630	---	580
Raccoon Creek	30.09	2,500	---	---	---	2,500
Strong Creek	30.56	830	---	285	---	545
Sandusky River	1420.7	102,240	1,800	11,830	22,080	66,530
Mills Creek	36.44	160	---	160	---	---
Pipe Creek	26.73	1,500	---	---	---	1,500
Cold Creek	8.17	955	---	955	---	---
Old Woman Creek	30.37	970	---	970	---	---
Huron River	403.4	35,870	1,820	1,495	2,205	30,350
Vermilion River	271.7	7,875	730	2,435	---	4,710
Quarry River		2,480	---	---	---	2,480
Quarry Creek	6.51	4,505	---	1,655	---	2,850
Martin Run	4.26	3,000	---	3,000	---	---
Black River	466.8	65,600	1,005	7,570	---	57,025
Cahoon Creek	5.44	12,905	12,905	---	---	---
Rocky River	293.8	67,847	1,904	10,393	430	55,120
Cuyahoga River	813.3	1,177,138	14,798	20,155	19,765	1,122,420
Euclid Creek	23.15	1,200	---	---	---	1,200
Chagrin River	267.0	24,480	---	12,325	7,950	4,205
Mentor Marsh		3,640	---	---	3,640	---

TABLE V-1 "Continued"
LAKE ERIE MUNICIPAL WASTE TREATMENT FACILITIES

River Subbasin	Drainage Area (sq. miles)	Estimated Population Equivalent				
		Total	Unsewered		Sewered	
			1	2	Primary	Secondary
Arcola Creek	10.15	1,970	---	500	---	1,470
Grand River	712.1	31,225	---	6,840	19,460	4,925
Wheeler Creek		500	---	500	---	---
Cowles Creek	22.16	5,380	---	---	---	5,380
Indian Creek	16.84	350	---	350	---	---
Ashtabula River	137.1	1,095	---	1,095	---	---
Conneaut River	191.2***	5,130	---	5,130	---	---
Direct to Lake Erie		1,770,085	1,635	7,455	652,900	1,108,095
		4,599,975	59,682	169,538	756,905	3,613,850
INDIANA						
Maumee River	6586.3*					
St. Joseph River	1060.4*	20,020	---	5,105	---	14,915
St. Marys River	816.7*	16,940	---	10,050	---	6,890
Upper Maumee River		212,925	---	985	---	211,940
		249,885	---	16,140	---	233,745
MICHIGAN						
St. Clair River-Lake St. Clair Basin						
Black River	590	20,800	---	4,100	---	16,700
Belle River	210	9,000	---	600	---	8,400
St. Clair River		63,100	---	3,200	59,900	---
Clinton River	760	288,500	---	66,500	---	222,000
Lake St. Clair		9,000	---	2,500	---	6,500
Totals for basin		390,400**	---	76,900	59,900	253,600

** Population does not include communities discharging to interceptor systems connected to Detroit Sewage Treatment Plant.

***Drainage area for Conneaut River includes 37.7 sq. miles in Ohio and 153.5 sq. miles in Pennsylvania

TABLE V-1 "Continued"
LAKE ERIE MUNICIPAL WASTE TREATMENT FACILITIES

River Subbasin	Drainage Area (sq. miles)	Estimated Population Equivalent				
		Total	Unsewered		Sewered	
			1	2	Primary	Secondary
Detroit River		3,457,400	—	135,800	3,321,600	—
Huron River	892	171,600	—	17,000	8,900	145,700
Raisin River	1070	60,000	—	7,000	25,600	27,400
Maumee River Basin	6586.3*					
St. Joseph River	1060.4*	2,700	—	2,700	—	—
Tiffin River	804.5*	6,645	2,055	2,040	—	2,550
Direct to Lake		9,400	—	9,400	—	—
		4,098,145	2,055	250,840	3,416,000	429,250
PENNSYLVANIA						
Conneaut River	191.2***	4,440	—	2,060	—	2,380
Raccoon Creek	8.95	500	—	—	—	500
Crooked Creek	21.2	760	—	760	—	—
Elk Creek	101	5,660	—	915	25	4,720
Trout Run	5.88	1,640	—	—	—	1,640
Walnut Creek	36.1	2,000	—	—	—	2,000
Sevenmile Creek	8.70	255	—	—	—	255
Sixteenmile Creek	18.4	13,145	—	—	—	13,145
Direct to Lake Erie		173,500	—	500	—	173,000
		201,900	—	4,235	25	197,640
NEW YORK						
Chautaqua Creek	36	3,800	—	—	—	3,800
Cornell Creek		500	—	500	—	—
Slippery Rock Creek		1,415	1,415	—	—	—
Beaver Creek		130	130	—	—	—
Canadaway Creek	40	37,640	140	—	—	37,500
Silver Creek	52	4,215	—	4,215	—	—
Cattaraugus Creek	565	18,035	130	8,150	7,825	1,930

TABLE V-1 "Concluded"
LAKE ERIE MUNICIPAL WASTE TREATMENT FACILITIES

River Subbasin	Drainage Area (sq. miles)	Estimated Population Equivalent				
		Total	Unsewered		Sewered	
			1	2	Primary	Secondary
Big Sister Creek		5,240	---	3,665	---	1,575
Muddy Creek		422	---	422	---	---
Pike Creek		2,500	---	2,500	---	---
Eighteenmile Creek	110	17,155	300	1,400	5,920	9,535
Rush Creek		25,300	---	600	---	24,700
Smoke Creek		42,035	---	5,855	290	35,890
Buffalo River	842					
Buffalo River		22,110	---	590	6,320	15,200
Buffalo Creek		4,785	4,000	785	---	---
Cayuga Creek		17,160	---	300	13,700	3,160
Cazenovia Creek		27,895	---	2,925	---	24,970
Totals for Buffalo River		71,950	4,000	4,600	20,020	43,330
Niagara River U. S. Subbasin						
Niagara River		1,163,174	---	2,400	1,099,174	61,600
Tonawanda Creek	768	71,055	---	960	4,945	65,150
Totals for basin		1,234,229	---	3,360	1,104,119	126,750
Direct to Lake Erie		31,320	700	8,015	22,605	---
		1,495,886	6,815	43,282	1,160,779	285,010

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In Ohio, the largest municipal waste sources are discharged either directly into the Lake or into the Cuyahoga, Maumee, or Sandusky Rivers. Of the 1.8 million sewered PE bordering Lake Erie, 1.3 million are handled by two Cleveland sewage treatment plants. The Cleveland Easterly Plant provides secondary treatment for approximately one million PE, and the Cleveland Westerly Plant provides primary treatment for some 300,000 PE. The Cleveland Southerly sewage treatment plant and Akron handle wastes from approximately one million of the 1.2 million PE discharging into the Cuyahoga River. Both plants provide secondary treatment.

The Maumee River's largest waste sources are Toledo in the Lower Maumee River area, and from Fort Wayne, Indiana in the Upper Maumee River area. The Toledo Plant provides secondary treatment for 600,000 PE, and Fort Wayne gives secondary treatment for 200,000 PE.

The Sandusky River receives wastes from municipalities whose total population is about 100,000 PE. The cities of Fremont and Bucyrus with secondary treatment serve approximately 30,000 and 18,000 PE, respectively. The city of Tiffin with primary treatment

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serves about 19,000 PE.

Approximately 79 percent of the total municipal waste in Ohio-Lake Erie Basin receives secondary treatment. About 3.5 percent of the population are not served by sewer systems.

In the Michigan basin most of the population is centered in and around Detroit. The Detroit Primary Sewage Treatment Plant serves about 3.1 million people. Although 94 percent of the Southeastern Michigan population is sewered, only 11 percent of the total population receives secondary treatment.

In New York, the wastes from 78 percent of the population receives primary treatment. The cities of Buffalo, Niagara Falls, and part of Tonawanda have sewage treatment plants that provide only primary treatment. These three cities serve over a million of the 1.2 million people receiving primary treatment.

The wastes from almost 100 percent of the sewered population in Pennsylvania receive secondary treatment. The city of Erie is the largest city in Pennsylvania that discharges directly to Lake Erie and provides treatment for 173,000 PE or about 90 percent of the sewered PE.

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Industrial Pollution

Industrial waste information in this report was obtained from records of the Michigan Water Resources Commission, Indiana Stream Pollution Control Board, Ohio Department of Health, Pennsylvania Sanitary Water Board, and New York Water Pollution Control Board.

Industrial Waste Sources

State Classification

State	Inadequate	Unknown	Total
Ohio	36	9	161
Indiana	2	-	11
Michigan	19	8	76
Pennsylvania	2	2	9
New York	4	7	14
Total	63	26	271

The above tabulation shows that there are 271 known sources of industrial wastes that discharge to the Lake and tributaries. The states have classified about 23 percent of these industries as having inadequate treatment facilities. The adequacy of an additional 10 percent of the industries has not been determined. Table V-2 lists the total number of industries in each major subbasin. The individual industries are listed in Parts 2 and 3 of this report, which follow.

(Table V-2 is as follows:)

Table V-2

INDUSTRIES IN LAKE ERIE BASIN DISCHARGING DIRECTLY TO PUBLIC WATERS

River Subbasin	Total Industrial Plants	Industrial Plants With Inadequate Treatment[1]
Ohio		
Maumee River		
Auglaize River	11	2
Lower Maumee River	9	1
St. Joseph River	2	--
St. Marys River	3	--
Tiffin River	1	--
Upper Maumee River	3	1
Totals for Maumee	29	4
Portage River	7	1
Sandusky River	5	--
Huron River	2	1
Black River	13	1
Rocky River	2	--
Cuyahoga River	24	16
Chagrin River	5	--
Grand River	5	1
Ashtabula River	6	3
Minor Tributaries to Lake	10	2
Direct to Lake	10	1
Total for Ohio	118	30
Indiana		
Maumee River		
St. Joseph River	4	--
St. Marys River	2	1
Upper Maumee River	7	1
Total	13	2

---

[1] Status of waste treatment facilities as reported by state water pollution control agencies.

Table V-2 (continued)

INDUSTRIES IN LAKE ERIE BASIN DISCHARGING DIRECTLY TO PUBLIC WATERS

River Subbasin	Total Industrial Plants	Industrial Plants With Inadequate Treatment[1]
Michigan		
Detroit River	21	5
Rouge River	14	5
Total for Basin	35	10
Huron River	12	1
Raisin River	9	6
Direct to Lake	1	--
Total for Michigan	57	17

---

[1] Status of waste treatment facilities as reported by state water pollution control agencies.

Table V-2 (concluded)

INDUSTRIES IN LAKE ERIE BASIN DISCHARGING DIRECTLY TO PUBLIC WATERS

River Subbasin	Total Industrial Plants With Adequate Treatment	Industries With Inadequate Treatment[1]
Pennsylvania		
Conneaut River	1	--
Tributaries to Lake	5	--
Direct to Lake	1	2
Total for Pennsylvania	7	2
New York		
Buffalo River	2	4
Cattaraugus Creek	2	--
Tributaries to Lake	6	--
Total for New York	10	4

---

[1] Status of Waste Treatment Facilities as reported by State water pollution control agencies.

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Table V-3 lists the industrial establishments that discharge directly to the Lake or to the lower rivers in the Lake-affected areas. A total of 53 industries are known to discharge in this area. This represents about 20 percent of total industrial discharges in the basin. Of these 53 industries, 22 are reported to have inadequate treatment facilities by the State agencies.

Data have not been made available for the computation of meaningful waste loads from industries.

(Table V-3 is as follows:)

Table V - 3

LAKE ERIE

INDUSTRIAL WASTES DISCHARGED DIRECTLY TO LAKE-AFFECTED PORTIONS OF RIVERS

Industry	Type of Waste	State Classification	Required Improvements Reported by State Agency
Ohio			
	Maumee River (0 - 14.9 Miles)		
Standard Oil Co.	Oil Refinery		
Gulf Oil Co.	Oil Refinery		
Interlake Iron	Steel		Solids
Sun Oil Co.	Oil Refinery		
Toledo Edison	Power		
Libbey-Owens Fords	Glass Manufacture		
Allied Chemical	Plastics		
	Black River (0 - 10.2 Miles)		
U. S. Steel Corp.	Steel		
	Cuyahoga River (0 - 6.6 Miles)		
Republic Steel	Steel		
Bolt & Nut Div.	Acid Iron	I	Pickling Liquor
Mill Scale			
Standard Oil Corp.	Oil Refinery		
#1		I	Oil and phenol
#2			
U. S. Steel Corp.	Steel		
Blast Furnace		I	Solids
Pickling		I	Pickling Liquor
Mill Scale		I	Solids
E. I. DuPont	Chemical	I	Metals
Republic Steel			
Coke Plant			
Blast Furnace		I	Solids - Increase efficiency
Rolling Mill		I	Oil & Solids - Increase efficiency
Pickling			

I - inadequate as reported by State water pollution control agencies.

Table V - 3 (Continued)

LAKE ERIE

INDUSTRIAL WASTES DISCHARGED DIRECTLY TO LAKE-AFFECTED PORTIONS OF RIVERS

Industry	Type of Waste	State Classification	Required Improvements Reported by State agency
	Cuyahoga River (0 - 6.6 Miles)		
J. L. Steel Corp.	Steel	I	Pickling Liquor
Pickling		I	Pickling Liquor
Blast Furnace			
Mill Scale			
Harshaw Chemical Co.	Chemicals	I	Reduction of metallic salts
Sherwin-Williams	Chemicals	I	Acids & Alkaline Sludges
Elco Lubricant Corp.	Oil	I	Acids & Alkaline Sludges
	Grand River (0 - 2.3 Miles)		
Diamond Alkali Co.	Chemical		
U. S. Rubber Co.	Chemical		
	Ashtabula River (0 - 3.3 Miles)		
Olin Mathieson	Chemical	I	Solids pH
Cabot Titania Corp.	Chemical	I	Solids
Titania Dioxide Plant	Chemical	I	Solids
Titania Tetrachloride	Chemical	I	Solids - Chloride
Detrex Chemical Ind.	Chemical	I	Iron Hydrocarbon
Reactive Metals	Chemical		
Sodium & Chloride Plant		I	Solids
Metal Reduction Plant		I	Solids and pH
Extrusion Plant			
Diamond Alkali Co.	Chemical	I	Solids
General Tire & Rubber Co.	Chemical	I	Solids

I - inadequate as reported by State water pollution control agencies.

Table V - 3 (Continued)

LAKE ERIE

INDUSTRIAL WASTES DISCHARGED DIRECTLY TO LAKE-AFFECTED PORTIONS OF RIVERS

Industry	Type of Waste	State Classification	Required Improvements Reported by State Agency
	Direct to Lake Erie		
Aluminum & Magnesium Co., Sandusky, Ohio	Metals		
United States Gypsum Gypsum	Paper	I	Solids
Cleveland Electric Illuminating Co.	Power		
Avon Lake			
Eastlake		I	Solids
Ashtabula			
Ohio Edison Co. Lorain	Power		
The Lubrizol Corp. Wickliffe	Chemical		
Thompson Ramo Woolridge Euclid	Metal Finishing	I	Metals Reduction
Industrial Rayon Co. Painesville	Textile	I	Metals Reduction
Union Carbide Corp. Metals Division Ashtabula	Steel Acid-Iron		
Detrex Chemical Ind. Chloro-Alkali Plant Ashtabula	Chemical		
Pennsylvania			
	Direct to Lake Erie		
Hammermill Paper Co. Erie, Pa.	Paper	I	
Interlake Iron Corp. Erie, Pa.	Metal	I	
Pennsylvania Electric Erie, Pa.	Flyash		

I - inadequate as reported by State water pollution control agencies.

Table V - 3 (Continued)

LAKE ERIE

INDUSTRIAL WASTES DISCHARGED DIRECTLY TO LAKE-AFFECTED PORTIONS OF RIVERS

Industry	Type of Waste	State Classification Required Improvements Reported by State Agency
New York		
	Direct to Lake Erie	
Bethlehem Steel Co. Lackawanna	Steel	
Penn-Dixie Cement Co.	Inorganic Solids	I
Michigan		
	Direct to Lake Erie	
Detroit Edison Enrico-Fermi Station	Power	

I - inadequate as reported by State water pollution control agencies.

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Inputs

The waste substances that are discharged to the Lake from municipal and industrial outfalls, tributaries, and land drainage are many, and their effects on water uses are varied. Many substances such as acid, oil, cyanide, iron, phenol, and oxygen consuming materials have severe effects on water uses in the localities of the discharge. These will be dealt with in discussions of local water use problems and damages.

These substances that have damaging effects on the water use of the total waters of the Lake are suspended solids (sediment), carbonaceous oxygen consuming materials, nitrogen compounds and soluble phosphate. A discussion of chlorides and dissolved solids is also included, not because they have reached damaging concentrations, but because their dramatic increases are indicative of the rate at which water quality has been degraded. Tables V-4 to V-8 present summaries of the major known inputs of these substances to Lake Erie.

(Tables V-4 to V-8 are as follows:)

TABLE V-4
CHLORIDE INPUTS TO LAKE ERIE

Source	Pounds/Day
MICHIGAN	
Head of Detroit River	6,500,000
Additions to Detroit River (incl.Canada)	11,500,000
Discharges by	
Huron River	90,000
Raisin River	140,000
OHIO	
Discharges by	
Maumee River	440,000
Portage River	100,000
Sandusky River	170,000
Black River	170,000
Rocky River	110,000
Cuyahoga River	660,000
Chagrin River	60,000
Grand River	2,200,000
Ashtabula River	20,000
Municipalities	
Toledo	80,000
Sandusky	7,000
Lorain-Avon	17,000
Lakewood	10,000
Cleveland-Westerly	37,000
Cleveland-Easterly	140,000
Euclid	14,000
Industrial--Direct to Lake--Ohio	unknown
PENNSYLVANIA	
Municipalities	
Erie	12,000
Small Sources	-
Industrial	unknown
NEW YORK	
Buffalo River	70,000
Other Sources	4,000
CANADA (other than Detroit River)	unknown
Sum of Known Sources	22,551,000
Discharged at Niagara River	25,100,000

TABLE V-6
SUSPENDED SOLIDS INPUTS TO LAKE ERIE

Source	Pounds/Day
MICHIGAN	
Discharge by	
Detroit River	8,600,000
Huron River	10,000
Raisin River	48,000
OHIO	
Maumee River	1,600,000
Portage River	130,000
Sandusky River	130,000
Black River	73,000
Rocky River	84,000
Cuyahoga River	490,000
Chagrin River	70,000
Grand River	360,000
Ashtabula River	15,000
NEW YORK	
Buffalo River	100,000
TOTALS--Major Known Sources	11,710,000

TABLE V-[illegible]
TOTAL NITROGEN INPUTS TO LAKE ERIE

Source	Pounds/Day
MICHIGAN	
Discharge by	
Detroit River	500,000
Huron River	1,600
Raisin River	3,800
OHIO	
Tributaries	
Maumee River	65,000
Portage River	19,600
Sandusky River	*
Black River	13,200
Rocky River	*
Cuyahoga River	52,100
Chagrin River	*
Grand River	4,000
Ashtabula River	*
Municipalities	
Toledo	40,000
Sandusky	3,500
Lorain-Avon	8,700
Lakewood	5,200
Cleveland-Westerly	19,000
Cleveland-Easterly	71,000
Euclid	6,900
Industrial--Direct to Lake	*
PENNSYLVANIA	
Erie	12,000
NEW YORK	
Buffalo River	*
Other Sources	2,100
CANADA (other than Detroit River)	*
Sum of Known Inputs	821,700

* unknown

TABLE V-8
SOLUBLE PHOSPHATE INPUTS TO LAKE ERIE

Source	Pounds/Day
MICHIGAN	
Discharge from Lake Huron	11,800
Municipal	70,000
Industrial	10,000
Tributaries	
Huron River	2,000
Raisin River	900
OHIO	
Municipalities	
Toledo	8,400
Sandusky	1,000
Lorain-Avon	2,600
Lakewood	1,100
Cleveland Westerly	5,400
Cleveland Easterly	14,900
Euclid	2,100
Industrial--Direct Discharge	unknown
Tributaries	
Maumee River	11,000
Portage River	1,100
Sandusky River	6,000
Black River	3,100
Rocky River	3,400
Cuyahoga River	3,500
Chagrin River	300
Grand River	--
Ashtabula River	100
PENNSYLVANIA	
Erie	2,600
Other Sources	2,900
NEW YORK	
Buffalo River	2,300
Other Sources	2,500
CANADA (est.-Municipal)	5,000
Sum of Major Known Sources	174,000
Discharged at Niagara River	24,000

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Suspended Solids

Damage to Lake Erie resulting from suspended matter entering from waste discharges and tributaries are dependent on the nature and its deposition results in enriched bottom muds or sludge banks, having largely local effects. Proper treatment for removal of these wastes can correct this problem. Suspended matter from certain industries and the material from tributaries, originating as land runoff is largely inorganic and its effects on settling result in the filling of harbors, embayments, ship channels and the Lake.

The principal sources of suspended solids discharged to Lake Erie are the Detroit, Maumee, Cuyahoga and Grand Rivers which represent a total of 11,000,000 pounds per day of known discharges. The Detroit River constitutes 78 per cent of this total, the Maumee 14.5 per cent, the Cuyahoga 4.5 per cent, and the Grand 4 per cent.

About 1.5 million pounds of the Detroit River discharges are from industrial and municipal sources. The Maumee discharges are largely silt originating from land runoff. The greatest quantity is released during periods of heavy rain and high runoff, therefore control must be instituted through improvements in land use practices on the watershed. The Cuyahoga sediment load includes industrial sources as well as both municipal and land runoff loads. The effects of this load on the Cleveland harbor and channels result in severe discoloration and the need for frequent dredging. The Grand River sources are similar to the Cuyahoga.

Carbonaceous Oxygen Consuming Materials

Carbonaceous oxygen consuming materials, usually measured by the 5-day biochemical oxygen demand (BOD), are usually considered direct pollutants to streams in that they depress dissolved oxygen levels. This immediate effect is not evident in lakes such as Lake Erie. However, BOD is a measure of wastes that are used by bacteria in cell growth and reproduction, thereby creating sludge which settles to the lake bottom. Thus BOD is a measure of wastes which produce the same end effect as nutrients as discussed below. Carbonaceous BOD of wastes is most effectively removed by secondary treatment.

Chloride

The concentration of chloride averaged

7 mg/1 in the headwaters of the Detroit River and 23 mg/1 at Buffalo, a threefold increase. Major known sources of input are the municipal and industrial contributions at Detroit, about 3 million pounds per day, the Grand River 2.2 million pounds/day and the Maumee and Cuyahoga 1 million pounds/day.

A large input of chloride from street and highway salting for ice control during winter ultimately drains to the Lake through municipal sewers and tributaries. Salt use for this purpose in 1964 was at least 800,000 tons which represents an increase of at least 2.4 mg/1 to the chloride level of the Lake water.

Dissolved Solids

Dissolved solids concentrations at the head of the Detroit River average 126 mg/1 and at Buffalo 192 mg/1.

The concentration of dissolved solids in Lake Huron has increased from 110 mg/1 in 1900 to 115 mg/1 at present, whereas the increase in Lake Erie at Buffalo in the same period was from 115 to 192 mg/1.

Nitrogen Compounds

The major known sources of nitrogen compounds entering Lake Erie are listed in Table V-7. The largest

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input is the Detroit River, which consists of the nitrogen residual from the upper Great Lakes and the contributions from the Detroit metropolitan area. Other major sources are the Maumee and Cuyahoga Rivers and the industrial and municipal discharges at Toledo and Cleveland.

The origin of these nitrogenous materials is largely from organic wastes, with sizeable contributions from specific manufacturers of ammonia and nitrogen salts. Except for local effects of discharges of these materials, the principal effect on Lake Erie is that of fertilization. Both nitrogen and phosphate are critical materials in the control of lake fertilization, however the nitrogen compounds are less amenable to control partly because control methods are not fully developed and partly because conversion of nitrogen from the air by some aquatic organisms can provide sufficient nitrogen to support algal growth. For these reasons, the abatement of pollution from lake fertilization through phosphate control provides greater potential for success than control of nitrogen inputs. However, the institution of secondary treatment will significantly reduce nitrogen inputs and thereby aid in the control of local problems as well as reduction in total inputs to the Lake.

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Soluble Phosphate

Phosphorus, in its inorganic form of orthophosphate (PO_4) is an essential element of biological life. It is used extensively as an agricultural fertilizer. All animals and plants require phosphate for normal growth and reproduction.

Because phosphate is so important to biological life it can become a controlling factor in the rate of growth or size of crop, and under conditions of limited abundance as prevails in Lake Erie it is the one factor most easily controlled.

The pollution caused by phosphate in Lake Erie results in uncontrollable production of algae followed by decay of this organic matter produced in the Lake. The decay, in turn produces zones of oxygen depletion, as has been evidenced by studies in the past and the recently revealed zone of serious oxygen depletion of 2600 square miles of the central basin. The productivity and decay that caused this tremendous loss of oxygen was of massive proportions. In 1964 it produced an oxygen deficit estimated at 270,000,000 pounds. The total of all oxygen consuming wastes from man-made sources now entering the lake is only a small portion of the oxygen demand causing this deficit.

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Phosphate inputs from principal sources are presented in Table 8 of the report. Of the total of 174,000 pounds of soluble phosphate discharged from known sources daily, 67 per cent is from municipal and industrial sources discharging directly to the Lake and 33 per cent from tributaries (including the St. Clair River), and other small sources. The St. Clair River input is 6.8 percent of this total. All other sources are amenable to some degree of control.

A 65 per cent reduction of phosphate inputs can be achieved through secondary sewage treatment, operated to effect optimum phosphate removal. Secondary treatment provides additional benefits through greater reduction of oxidizable organic matter, disease-causing organisms, phenolics, nitrogen, and other waste materials.

The major controllable sources referred to in Table 8 of the report and the amount of reduction that can be achieved by the secondary treatment described above are:

Detroit	45,500
Toledo	2,900
Sandusky	700
Lorain-Avon	1,700
Lakewood	600
Westerly	3,500
Easterly	6,800
Euclid	1,300
Erie	1,300
Total municipal reduction	64,300
80% reduction Michigan industry	8,000
Total municipal and industrial reduction	72,300

Thus, at least 40 per cent of present PO_4 input can be reduced by secondary treatment at the principal waste sources. This alone would significantly reduce algae growths in the Lake. Therefore, the first requirement for phosphate pollution control in Lake Erie is the construction of secondary treatment plants where they do not now exist and improved treatment

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These reductions, based on present day factors, must be constantly improved in order to account for increases in phosphate loadings resulting from population, industrial and agricultural growth.

Even with the institution of secondary treatment, and operation of treatment plants for optimum phosphate removal, the reduction in phosphate inputs will require several years, and no sudden or dramatic reductions in Lake algal productivity can be expected. Therefore, top priority must be given to the earliest construction and operation of those plants at which the highest removals can be achieved; namely Detroit, Toledo, Cleveland, and Erie. After these treatment practices are in operation it can be reasonably expected that significant improvement in the water quality in Lake Erie will be observable within a few years. At that time, the effects of these measures should be reevaluated to determine if further reduction of nutrients by additional treatment will be necessary.

The conclusions and recommendations of Part 1 of the report will follow Part 2 of the report.

Remaining in Part 1 is a report on Federal installations in the Lake Erie Drainage Basin.

The Federally-owned or Federally-leased installations listed below discharge wastes to surface waters or to the ground. Installations that discharge to municipally-operated sewerage systems, with a few exceptions, have not been listed since the Federal Government does not control the kind of treatment provided. Federal installations in Michigan are not included in this report since they have been discussed in the "Report on Pollution of the Detroit River, Michigan Waters of Lake Erie, and Their Tributaries," April 1965.

Waste treatment facilities are adequate at the following installations:

GSA Materials Depot, New Haven, Indiana
The Lewis Research Center, NASA, Plum Brook, Ohio
Air Force Plant No. 49, Buffalo, N. Y.
Nike Site 41, Buffalo, N. Y.
Nike Site 18, Buffalo, N. Y.
Nike Site 9, Buffalo, New York
Iroquois National Wildlife Refuge, Genesee County, N. Y.
Coast Guard, Marblehead Lifeboat Station, Ohio
Coast Guard, Put-In-Bay Light Station, Ohio
Coast Guard, Sandusky Bay Lifeboat Station, Ohio
Coast Guard, Chesterland Radio Station, Gates Mills, Ohio
Coast Guard, Erie Lifeboat Station, N. Y.
Coast Guard, Buffalo Lifeboat Station, N. Y.

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Waste treatment facilities are inadequate at the following installations:

Erie Army Depot, Port Clinton, Ohio

This Army depot is scheduled to be phased out by December 31, 1966. All sewage from approximately 1,800 persons receives secondary treatment (activated sludge) and chlorination. The average dry weather discharge is 0.12 mgd. Waste waters from boiler blowdown, air conditioning, compressor cooling, plating rinse solutions, and laundry facilities are discharged to the storm sewer system. Approximately 200,000 gpd are discharged to Rusha Creek from the latter system. Because of the planned closing of this installation, no improvements will be made for handling industrial wastes from such operations as metallic plating.

The Lewis Research Center, NASA, Cleveland Facility, Ohio

This installation employs approximately 3,500 persons. All sewage and some cooling water are discharged (1 mgd) to the Cleveland city sewers. Cooling water from test stands and research facilities flows to two 1 MG capacity settling basins, operated on a fill and draw basis, and then to the Rocky River. Water with high chromate concentrations from intermittent cooling tower blowdown is held in the settling basins and released to the city system after dilution. Approximately 1.4 mgd of cooling water is discharged to the Rocky River through storm sewers. Owing to increased operations of both NASA and a nearby Army automotive plant, the main sanitary sewer serving both installations now has insufficient capacity to carry the entire flow during heavy storm run-off periods. This problem is currently being investigated.

Cleveland Army Tank Automotive Plant, Cleveland, Ohio

This plant located adjacent to the NASA facility described above employs approximately 2,100 persons in engineering design and manufacture of military armored vehicles. Industrial wastes receive treatment that includes anthracite filtration, neutralization, chemical coagulation, and chlorination. Discharge to the Rocky River is intermittent depending on production. The industrial treatment plant is operating satisfactorily and is under the supervision of a qualified chemist. All sewage is discharged to a sewer which also serves the nearby NASA facility. Owing to the insufficient hydraulic capacity of this sewer to transport all wastes from the two installations to the Cleveland municipal sewerage system, a by-pass to Rocky River has been provided. By-passing occurs only during storms. The presence of storm water in the sewer is possibly due to infiltration or unknown connections at the Cleveland Airport. The problem is now being investigated.

Perry's Victory and International Peace Memorial National Monument, South Bass Island, Ohio

Sewage from the public comfort station located below the monument is treated by a septic tank and drain field. The superintendent's home and the National Park Service Office at the Monument are each served by two septic tanks, and the effluent is discharged to the Put-In-Bay sewer system which discharges to Lake Erie without further treatment.

Post Office, Silver Creek, New York

Sewage from 12 employees flows to a septic tank and then to the Silver Creek storm sewer system without further treatment. The City of Silver Creek does not have a municipal sanitary sewerage system.

Post Office, Springville, New York

Sewage, 160 gpd, from 10 to 12 employees is discharged to a septic tank system. The City of Springville has recently constructed a sanitary sewerage system to which the Post Office could make a connection.

Niagara Municipal Airport Air Base Group, New York

Sewage and airplane wastes are treated by a sewage treatment plant consisting of two Imhoff tanks and six intermittent sand-filters. Although chlorination facilities are available, they are not being used. Approximately 80,000 gpd is discharged to the Cayuga Creek.

Coast Guard Installations, Lake Erie

Toledo Harbor Light Station, Ohio

This station, located in the outer Toledo Harbor, discharges raw sewage from a complement of two. The Coast Guard is in the process of installing automatic equipment at the light station, and the station will not be a manned facility after October 1, 1965.

Lorain Lifeboat Station, Ohio

This installation has a complement of 12 and is served by a septic tank which discharges directly to the Black River. This facility is located less than 400 yards from the Lorain Sewage Treatment Plant. The outer harbor light station has a complement of two to three persons and discharges raw sewage into Lake Erie.

Cleveland Lifeboat Station, Ohio

This installation has a complement of 27 and is served by a septic tank which discharges directly to Lake Erie without further treatment. The light station was automated on July 1, 1965, and is no longer a manned facility. The Marine Inspection Office, which is located at the foot of Ninth Street in Cleveland, is served by a septic tank with direct discharge to the harbor.

Fairport Harbor Lifeboat Station, Ohio

This installation has a complement of 10 and is served by a septic tank with direct discharge to the Grand River.

Ashtabula Light Station

This station is located in the outer harbor and is manned by one to two persons. Sewage is discharged directly to Lake Erie without treatment. No definite plans have been made to automate this station.

For the record, the descriptions of the stations with adequate waste treatment facilities are as follows:

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GSA Materials Depot, New Haven, Indiana

Secondary treatment with ground discharge is provided for sewage from approximately 75 persons. Waste treatment facilities are adequate.

The Lewis Research Center, NASA, Plum Brook Facility, Ohio

This installation, located near Sandusky, has a complement of approximately 700. A primary treatment plant with chlorination treats wastes from 400 employees; two smaller secondary package treatment plants serve the rest. Septic tanks with disposal fields serve isolated buildings on the property. Small amounts of chemical and acid wastes are collected in underground holding tanks for disposal by a contract firm.

Nike Missile Sites, Cleveland Area

Site 29C

This site has a complement of 50. All sewage is discharged to a settling tank and subsurface sand-filter. The sand-filter was rehabilitated in the fall of 1964. Approximately 3,000 gpd are discharged to the above system which now appears to be operating well.

Site 34L

Approximately 2,500 gpd of sewage are being discharged to a system similar to the one serving Site 29C. The treatment facility appears to be operating well.

Post Office, Bellevue, Ohio

The Post Office has 27 employees. Sewage (250 gpd) and some storm water flow to a concrete-block-lined cesspool on the installation's property. The system appears hydraulically adequate to handle the flow. The City of Bellevue does not have a municipal sewerage system.

Air Force Plant No. 49, Buffalo, New York

This plant, owned by the U. S. Air Force, is operated under contract by the Metal Processing Division, of Curtis Wright Corporation. All sewage, 5,300 gpd, is discharged to the Buffalo City System. About 60,000 gpd of cooling water is discharged directly to the Scajaquada Creek. The cooling water does not contain wastes from processing. Waste disposal practices appear adequate.

Nike Sites, Buffalo Area, New York

Many of the Nike missile sites in this area have been phased out and are now operated by the New York

National Guard.

Site 41

Approximately 500 to 1,000 gpd of sewage is treated by a 1,000 gallon septic tank and sand-filter with post chlorination. The two original two-stage biofiltration units at this installation are not being used due to the insufficient flow.

Site 18

Approximately 1,200 gpd of sewage is discharged to a 1,000 gallon septic tank and sand-filter with post chlorination. The effluent is discharged to the Buffalo River.

Site 9

This installation has no permanent personnel and is used for drill practices by the National Guard. Approximately 2,000 gallons per month is discharged to a 1,000 gallon septic tank and subsurface disposal field.

The waste disposal practices at the above NIKE installations appear adequate.

Iroquois National Wildlife Refuge, Genesee County, New York

This facility is served by four separate septic tank systems with subsurface disposal fields.

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The installation has a Job Corps Center under construction which will be served by a septic tank and disposal field system. It is anticipated that this center will have a population of 130. The waste disposal systems appear to be operating satisfactorily.

Coast Guard Installations, Lake Erie

Marblehead Lifeboat Station, Ohio

This facility has a complement of 15 and is served by two septic tanks and a subsurface disposal field. This system is operating satisfactorily. One house trailer at the installation is served by a cesspool consisting of a 50 gallon punched oil drum.

Put-In-Bay Light Station, Ohio

This facility consists of a houseboat which is unmanned at this time. The houseboat is served by a retention tank with chlorination.

Sandusky Bay Lifeboat Station, Ohio

This installation has a complement of 25 and is served by three septic tanks and a subsurface disposal field. The sewerage system appears to be operating well.

Chesterland Radio Station, Gate Mills, Ohio

This facility has a complement of 21 and is served by a septic tank and subsurface disposal field.

The system seems adequate.

Erie Lifeboat Station, New York

This station has a complement of 23 and is served by a septic tank and subsurface disposal field. The system seems adequate.

Buffalo Lifeboat Station, New York

This installation has a complement of 20 and is served by a small aerobic package plant that provides secondary treatment. The treatment plant appears to be operating satisfactorily.

This concludes the first part of the report.

MR. STEIN: Thank you, Mr. Cook.

MR. POSTON: Mr. Chairman, I would like to ask that this total report be inclued as a part of the record, the total of the report meaning all three parts of it, and the conclusions.

MR. STEIN: If you put in all three parts at this time, it will be premature, but certainly Part 1 now, and I assume Part 2 will be put in as read.

MR. POSTON: Well, there were certain parts that were not read into the record, and we would like to include the total of the report.

MR. STEIN: That will be done, without objection. There are several charts and maps and tabular material and paragraphs which were left out. These will appear in the transcript as if read, without objection.

We will now recess until a quarter to two for lunch, and we will have questions of Mr. Cook as soon as we return. We will start promptly then and continue with the Federal presentation.

We stand recessed until a quarter to two.

(Whereupon, at 12:30 p.m., a luncheon recess was taken.)

AFTERNOON SESSION

1:45 P.M.

MR. STEIN: May we reconvene?

Mr. Poston.

MR. POSTON: Mr. Chairman, we would like to proceed with the rest of our report, to be presented by Mr. Megregian, and at the conclusion of Mr. Megregian's presentation, we would open it up for questions on both parts of the report.

Mr. Megregian.

STATEMENT OF MR. STEPHEN MEGREGIAN, GREAT LAKES-ILLINOIS RIVER BASIN PROJECT, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

MR. MEGREGIAN: Mr. Chairman, Conferees, ladies and gentlemen:

This is Part 2 of the report prepared for the conferences to be held at Cleveland, Ohio and Buffalo, New York, on pollution of Lake Erie and tributaries. Part 1 of the report concerned the main body of Lake Erie, its problems, their causes, and general remedial measures.

This part deals with problems in local areas tributary to Lake Erie within Michigan and Ohio, encompassing also headwater areas in Indiana. The area is divided into 6 subareas, each of which is discussed in one of the succeeding chapters.

I would like to begin reading the heading of each chapter, and then condense it a bit for purposes of expedition.

The first chapter is the Maumee River Basin.

Description of the Area

The Maumee River system drains portions of Indiana, Michigan, and Ohio. The major portion of the basin is quite flat, particularly the central part.

The soils in the major portion of the basin are predominantly fine textured, poorly drained, and relatively impermeable. The low dry-weather stream flow reflects the highly impermeable characteristics of the soils in the basin. Approximately 92 percent of the total acreage is devoted to agriculture.

The average discharge for the Maumee River at Waterville, Ohio, which records runoff from 96 percent of the basin, was 4600 cfs for a thirty-nine year period prior to 1965. Lowest average flow for a seven-day period having a recurrence interval of once in five years (80%) is 113 cfs.

At the 1960 census, the overall population of the Maumee River Basin was approximately 1,134,000 people. Principal centers of population and industry are Toledo and Lima, Ohio and Ft. Wayne, Indiana. Breakdown by states in the Basin is shown below.

Maumee River Basin Portion by State	Population
Michigan	24,000
Ohio	830,000
Indiana	280,000
Total Maumee Basin	1,134,000

Water Uses

Municipal Use

The total municipal water use by 171 communities in the watershed amounts to 128 mgd, of which 113 mgd are obtained from surface supplies and 15 mgd from underground supplies.

Five municipalities obtain their water supply directly from the Maumee River. These Ohio communities are Waterville, Bowling Green, Grand Rapid, Napoleon, and Defiance. The City of Ft. Wayne, Indiana uses the St. Joseph River as a source of water supply. The communities of Archbold, Wauseon, Findlay, Van Wert, Lima, Delta, Weston, and Swanton, Ohio have impounding reservoirs.

(Figure II-1 is as follows:)

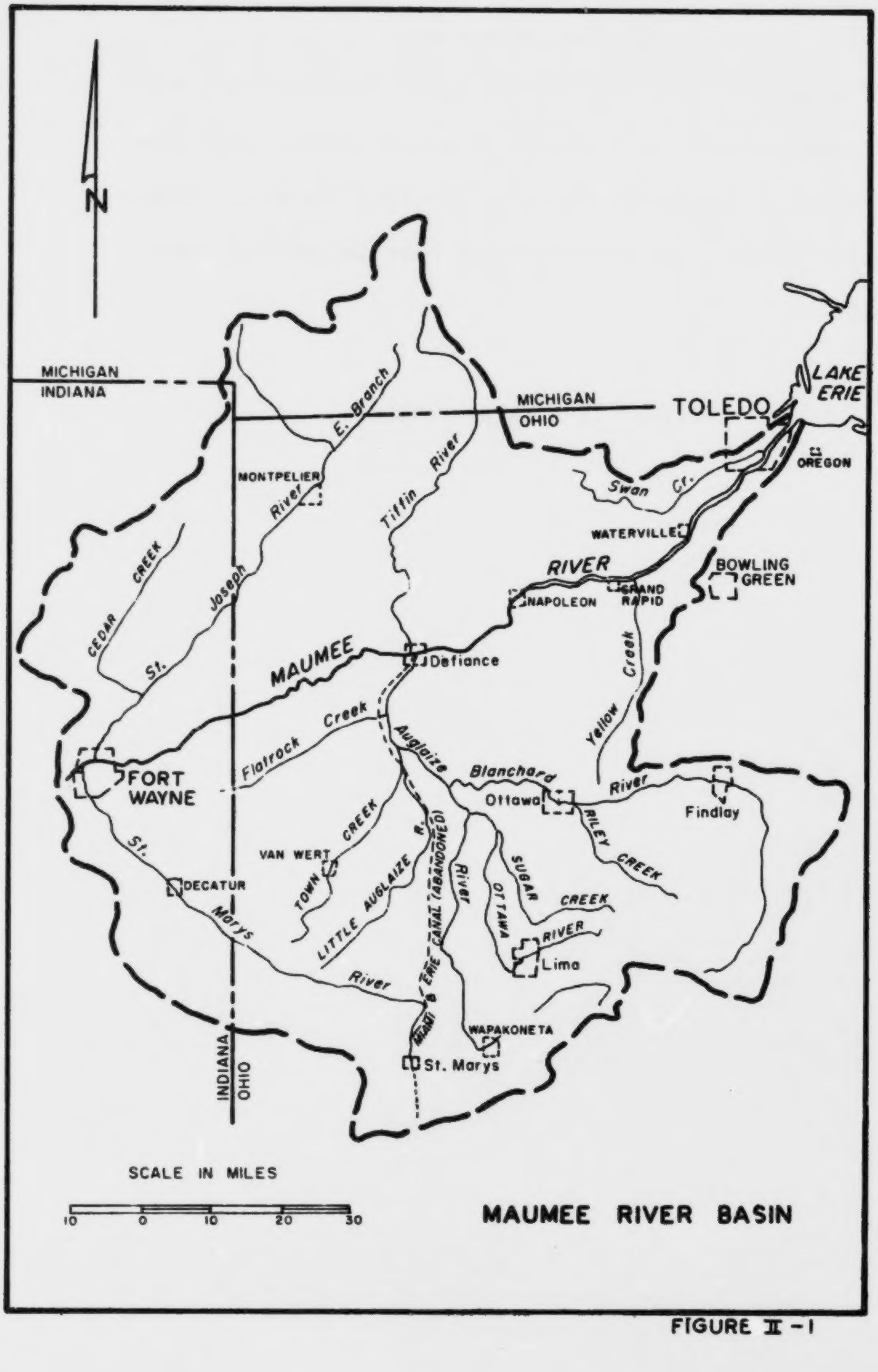
N
MICHIGAN
INDIANA
MICHIGAN
OHIO
TOLEDO
LAKE ERIE
OREGON
E. Branch
Tiffin River
MONTPELIER
River
Swan Cr.
WATERVILLE
BOWLING GREEN
RIVER
GRAND RAPID
NAPOLEON
CEDAR CREEK
St. Joseph
MAUMEE
Defiance
Yellow Creek
Flatrock Creek
Auglaize
Blanchard
River
Ottawa
Findlay
FORT WAYNE
RILEY CREEK
VAN WERT
TOWN CREEK
LITTLE AUGLAIZE R.
MIAMI & ERIE CANAL (ABANDONED)
River
SUGAR CREEK
OTTAWA RIVER
Lima
St. Marys River
DECATUR
WAPAKONETA
St. Marys
INDIANA
OHIO
SCALE IN MILES
10
0
10
20
30
MAUMEE RIVER BASIN

FIGURE II -1

The City of Toledo and its satellites draw an estimated 70 mgd from Lake Erie.

Industrial Water Use

The Campbell Soup Company, Napoleon, Ohio uses the Maumee River for water supply. The company pumps approximately ten million gallons of water per day for use in its soup processing. According to the census of all users, estimated by the Ohio Division of Water in 1955, manufacturing plants used a total of 190 mgd and power plants (municipally-owned, public utilities, and industrial) used a total of 642 mgd in the Ohio portion of the watershed, exclusive of Lake Erie.

Heavy industrial use in the Toledo area amounts to a very high percentage of the total water used in the Maumee River Basin. Ohio Division of Water, 1955, reported that of an estimated 756 mgd of water withdrawn in the area, manufacturing plants used 7.2 mgd, and one power company used 192 mgd directly from Lake Erie. The balance of the withdrawals was by the City of Toledo, other factories, and power plants.

Waterborne Commerce

Port facilities in Toledo provide the area with excellent service for water shipment of products on the Great Lakes and, through the St. Lawrence Seaway, to and from ports throughout the world.

The average annual tonnage for the years 1952 - 1959 at Toledo was 24.6 million short tons. Cargo consisted of petroleum, coal, iron ore, iron and steel, and grain.

Recreation

The recreational resources of this region are meager compared to those found immediately to the south and north. Lake Erie, polluted along much of its shoreline between Detroit and Toledo, offers little inducement for swimming. Inland areas of the region offer virtually no natural recreational facilities. The Grand Lake at St. Marys is classified as a state lake, but this one recreational unit is not in a suitable location for use by many within this region.

Facilities for recreational activities are also provided at Independence Dam State Park, Thurston State Reserve, and Cascade State Reserve.

Fish and Aquatic Life

Most streams of the basin do not provide good sport fishing due to their limited size, fluctuation of flow, pollution from municipal and industrial wastes, and soil erosion. The Maumee River in the shallows downstream from the old canal feeder dams near Defiance and Grand Rapid was once an outstanding fishing spot for smallmouth bass, rock bass, and channel catfish. According to the Division of Wildlife, Ohio Department of Natural Resources, smallmouth and rock bass, once prevalent, are now totally absent from these waters.

Irrigation

According to the 1955 report of the Ohio Division of Water, 1,550 acres are irrigated in the Ohio portion of the Maumee Basin. The total water withdrawal in this area for farm field irrigation in 1955 was 2.1 mgd, distributed equally between surface and ground water supplies.

Irrigation has shown a steady rise since 1950 and the trend toward irrigation is increasing.

Principal Sources of Wastes

The principal sources of pollution in the Maumee River Basin are municipal sewage, combined sewer overflows, and industrial wastes. Other pollution problems have resulted from accidental spills from storage tanks, lagoon breaks, and wastes from ships. Sediment losses from the basin, carried by the stream system into Lake Erie, are heavy. These losses result from a combination of soil characteristics and land use practices.

St. Joseph River

One primary treatment plant, in the Ohio part of this subbasin, treats wastes having an average population equivalent (PE) of 8500. There are six secondary treatment plants, located in Indiana, which treat wastes having a combined total PE of 15,000 before treatment. Twenty-three communities with a total population of 11,000 are not served by community sewerage facilities.

Six major industries operate in the St. Joseph subbasin, of which four are in Indiana and two in Ohio. The Indiana industries are Warner Automotive in Auburn; and Kitchen Quip, Crane-Edmund and Universal Tool in Butler. The two industries in Ohio are Edgerton Metals Products and Bundy Foods in Blakeslee.

St. Marys River

One primary treatment plant located in Ohio treats a total of 440 PE. Five secondary treatment plants have before-treatment PE of 26,000. Three of these are in Indiana and treat 6,900 PE. The remaining two treat 19,500 PE in Ohio. A total of 12,700 people in eleven communities are unsewered. Five of these communities with 10,000 people are in Indiana, with the remaining 2,600 people in Ohio.

Six major industries discharge to the St. Marys River. Dana Corporation Salisbury Axle Works, Essex Wire, and Central Soya Company are in the Indiana part. St. Marys, Ohio has Weston Paper Company, Goodyear Tire and Rubber Company, and Beatrice Foods Company discharging to the river in that city.

Tiffin River

Five secondary treatment plants have a before-treatment PE of 43,000. One plant is in Michigan having a PE of 2,600, while the remaining 4 are in Ohio. A total of 8,500 people in eighteen communities are unsewered in the Tiffin subbasin. Michigan has 4,100 people in 7 communities with Ohio having the remaining 4,400 in 11 communities.

One principal industry, Defiance Fertilizer Company, is on the Tiffin immediately above Defiance, Ohio.

Stephen Megregian

Auglaize River

The Auglaize River subbasin which includes the Ottawa and Blanchard Rivers has seventeen secondary sewage treatment plants receiving a PE of 167,000. In fifteen communities, 23,800 people are unsewered in this subbasin.

Thirteen major industries discharge to the waters of the Auglaize, Blanchard and Ottawa Rivers. Namco, an aluminum anodizing plant and Ohio Decorative Products, a plating opertion, discharge directly to the Auglaize River. Five major industries use the Blanchard River for waste disposal. These are in Findlay and include Contris Packing Plant, Davison Chemical Company and National Oil Refinery. The remaining two are Rusco, Inc., an aluminum plating company in Pandora, and Buckeye Sugar Inc., in Ottawa. The sugar mill discharges an average of 2,160 pounds BOD per day during seasonal operation, September-December. The remaining six industries in the Auglaize subbasin discharge into the Ottawa River and are located in Lima.

These are Ford Motor Company, Standard Oil Refinery, Republic Creosote, Sohio Petrochemical Company's acrylonitrile and acetonitrile plant. Sohio Chemical Company's petrochemical plant, and Excello

Company, a ferrous fabricated metal products plant. Phenolic and nitrogen compounds are discharged, causing problems in the Ottawa.

Upper Maumee River, Ft. Wayne, Indiana to Napoleon, Ohio

One primary treatment plant treats 9,700 PE in the Ohio portion. Five secondary treatment plants receive a total PE of 214,000, four of them being in Indiana. The largest is Fort Wayne, with a 207,000 population equivalent. A total of 3,500 people in six communities are unsewered. Ohio has 2,500 in four communities.

Industries number twelve in the Upper Maumee. Central Foundry and Lectrolite Company are located in Defiance and discharge directly to the Maumee. Discharging through the Defiance Sewage Treatment Plant is Johns Manville Company, having large quantities of phenolic materials as wastes. The fourth industry, Weatherhead Corporation, is at Antwerp, Ohio. Cyanide and oil discharges create a local problem. The remaining eight industries are in Indiana. B. F. Goodrich Rubber Plant is located near the Maumee at about mile point 119.0. This plant has sewage treatment facilities and discharges a small amount of BOD. Harvester Ditch below Ft. Wayne carries the wastes of four industries. These are Gladieux Oil Company, Phelps Dodge, Magnavox, and International Harvester. The BOD loading from this stream averages about 60 pounds per day. The remaining industries are Parrot Packing Company and two plating companies, General Plating and Franke Plating. The packing plant increases the BOD loading in the river below Ft. Wayne by 890 pounds per day. Oils are also contributed in the amount of 136 pounds per day. Two plating companies in Ft. Wayne contribute large amounts of cyanides and heavy metals. One company discharges on the average 38 pounds of cyanide per day.

Lower Maumee

Two primary treatment plants receive for treatment a PE of 3,700. Nine secondary treatment plants treat a total of 609,000 PE, of which a PE of 575,000 comes to the Toledo Sewage Treatment Plant. Even though secondary treatment is employed, this plant discharges on the average approximately 18,000 pounds of BOD every day into the river and Maumee Bay at the western tip of Lake Erie - an indicated reduction of 81 per cent by treatment. A total of 11,000 people in twenty-three communities are not served by central collection and treatment systems.

Seven industries discharge to the Maumee in the Toledo area. Three of these are oil refineries which include Standard, Gulf, and Sun. The remaining four are Interlake Iron Company, Toledo Edison, Libbey-Owens-Ford, and Allied Chemical Company. Oil scum, metallic deposits, and toxic materials are contributed by these industries.

Two major industries discharge into the lower Maumee above Toledo. Johns Manville at Waterville approximately 18.5 miles above the mouth discharges high concentrations of phenols which have reached levels of 1,100 micrograms per liter.

Campbell Soups is the other major industry. Located in Napoleon, Ohio, the soup processer discharges on the average 4,620 pounds of BOD and 268 pounds of oil.

Effects of Wastes on Water Quality and Water Uses

St. Joseph River

The overall water quality of the St. Joseph River above Montpelier, Ohio, is good. Below Montpelier the concentration of dissolved oxygen falls to an average of 4 mg/l during low flow. A minimum concentration of 2 mg/l was recorded several times during late summer. The treatment plant effluent has a DO (dissolved oxygen) of 4.5 mg/l and a BOD of 796 pounds per day. The flow of the stream during the sampling period at this point was 17 cfs or less 18 per cent of the year. Biological conditions typical of gross pollution existed during these low flows. The stream bottom is silt, mud, and detritus. An oily sludge was observed during low flow conditions. Bottom dwelling animals were limited to the pollution-tolerant sludgeworms and midge larvae.

St. Marys River

A dissolved oxygen sag occurs on the St. Marys River below the City of St. Marys. The combination of industrial wastes and the St. Marys sewage treatment plant effluent lowered the DO to below 4 mg/l about 85 per cent of the sampling period, June 1964 - March 1965. Four and one-half miles above this sampling point three major industries and a secondary sewage treatment plant, as tabulated below, discharge their wastes directly to the River:

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Waste Source	5 day BOD discharged
Weston Paper Manufacturing Company	320 lbs./day
Goodyear Tire and Rubber Company	344 lbs./day
Beatrice Foods Company	11 lbs./day
St. Marys Sewage Treatment Plant	290 lbs./day
Total industrial and municipal wasteload	965 lbs./day

During the period October - December 1964, the median coliform densities in this area were 540,000 per 100 ml with a range of 10,000 - 2,900,000. The maximum fecal streptococci densities recorded were 155,000 per 100 ml.

At certain times of the year, in addition to known waste inputs, large quantities of deoxygenating wastes are discharged to the river in the St. Marys area. The most recent occurrence was about May 15, 1965. The waters below St. Marys were black and septic. The dissolved oxygen was zero for 20 miles downstream.

Biological sampling in the early spring of 1964 disclosed a sparse population of pollution-tolerant midge larvae and sludgeworms. The stream bottom was sand, rubble, and rock, and no sludge deposits were found. By July, a black septic sludge had accumulated over the stream bottom and emitted a strong septic odor. Because of severe environmental conditions, no bottom dwelling organisms were found during the summer or fall surveys.

Another dissolved oxygen sag occurs downstream from Decatur, Indiana. Four mile below Decatur, the DO was below 4.0 mg/l for 20 per cent of the time during the period June 1964 - March 1964. The DO range was 1.4 - 11.8 mg/l. The maximum 5-day BOD concentration was 17.6 mg/l. The secondary waste disposal plant at Decatur discharges an estimated 240 pounds of BOD daily. The principal industry, Central Soya, releases only 4.3 lbs/day BOD from its oxidation ponds. Stream flows in this area during August - September, 1964 had monthly averages of less than 16 cfs. Although the BOD loading from the Decatur Sewage Treatment Plant is relatively low, the stream cannot accommodate these loads because of low flow during the summer and fall.

Auglaize River Basin

Since the majority of wastes discharged to the Auglaize River are received from its tributaries, sampling stations were positioned to determine the effect of streams discharging to the main stem.

The major sources of municipal and industrial waste discharged directly to the headwaters of the Auglaize are at Wapakoneta, Ohio. During the period July - November 1964, the sewage disposal plant at Wapakoneta discharged a variable BOD loading to the Auglaize ranging from 178 lbs. to 1700 lbs./day. Flow in the stream below this discharge was below 6.4 cfs during 90 per cent of the sampling period. The River receives industrial waste discharges at Wapakoneta from two packing companies, a Pepsi-Cola bottling plant, and the Monarch Battery Company. No records on the effluents from these industries have been made available. The dissolved oxygen below Wapakoneta falls to zero during low flow periods. Dissolved oxygen was below 4 mg/l downstream approximately 31 per cent of the time. During the period October - December, 1964, the median coliform density was 140,000 organisms per 100 ml, with a range of 1,200 to 11,000,000.

The Auglaize River above Wapakoneta supports a well-balanced biological population at all seasons of the year. Pollution-sensitive species of mayflies, caddis flies, and scuds were common. Below the town, the water quality is severely degraded. Although bottom fauna of pollution-sensitive mayflies, caddis flies, and dragon flies were found to be fairly numerous in the spring of 1964, by July all pollution-sensitive organisms had been eliminated and only sludgeworms and midge

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larvae remained. The stream bottom which had been scoured clean of silt and organic deposits during the spring was covered with black, septic, malodorous sludge by July. Below this point, the Auglaize River quickly recovers and for over 50 miles, dissolved oxygen, biochemical oxygen demand, microbiological and biological data gave little evidence of organic pollution.

The Ottawa River, a tributary of the Auglaize River, is grossly polluted -- the worst in the entire Maumee River Basin. The stream degenerates rapidly at Lima, Ohio, and never recovers. Thirty-three miles below Lima, the water was still highly colored, ranging at times from red-orange to black. Oil was also much in evidence along banks throughout the reach.

Above Lima, the median dissolved oxygen was approximately 5 mg/l. At station 31.8 below Lima, the dissolved oxygen was consistently below 1 mg/l. Thirty miles below Lima, at the stream's junction with the Auglaize, the median dissolved oxygen was still below 2 mg/l with many values near zero.

Biochemical oxygen demand values immediately below Lima ranged from a low of about 20 mg/l to approximately 215 mg/l. Near the mouth of the river, these BOD varied from 10 to 85 mg/l. Median coliform concentration in the Ottawa River ranged from 6,200 to 2,300,000 organisms per 100 ml for the entire sampling period. The median value for fecal coliform was 42,000 organisms per 100 ml, and for fecal streptococci 10,000 organisms per 100 ml. A severe bacterial pollution exists at all points sampled.

The high coliform densities, accompanied by high fecal coliform and fecal streptococci densities, confirm the presence of gross pollution from human wastes.

This heavy chemical pollution adversely affects water supplies on the Maumee. Phenolic concentrations directly below Lima ranged from 40 micrograms per liter to 10,000 micrograms per liter and at the mouth from 13 micrograms per liter to 1,400 micrograms per liter. Chemical oxygen demand (COD) values ranged from 30 mg/1 to 540 mg/1 below Lima and from 35 mg/1 to 515 mg/1 at the mouth. Concentrations of ammonia ranged from 22 mg/1 to 127 mg/1 below Lima with a median value of 63 mg/1. One mile above the mouth of the Ottawa River, ammonia concentrations ranging from 12 mg/1 to 136 mg/1 were detected. The median value for the period July 1964 - February 1965 was 60 mg/1.

Below Lima, rooted aquatic plants, attached algae, and bottom dwelling animals were completely absent in all seasons. The stream bottom is rock and shale which in the spring was scoured clean of any silt or sludge. During low flow in the summer, a black, oily sludge with a strong petrochemical odor accumulated over the stream's bottom. Between Lima and the confluence with the Auglaize River, the Ottawa showed no signs of biological recovery. The only aquatic life observed in this reach was a very sparse population of sludgeworms and midge larvae near the mouth. The rocks and shale were completely devoid of attached algae and aquatic weeds. The complete absence of attached algae and bottom dwelling animals indicates not only severe oxygen deficits but the presence of highly toxic chemicals.

Wastes discharged to the Ottawa River from the Sohio industrial complex at Lima include oil, phenolic compounds, ammonium nitrate, anhydrous ammonia, urea, aceto - and acrylo-nitriles and cyanides. It has not been possible to obtain details of industrial waste effluents from this complex. Other significant wastes are 24 lbs./day of oil from Excello Corporation, 19 lbs./day oil and 7.7 lbs./day of phenol from Republic Creosote. Ford Motor Company discharges its wastes to Sugar Creek, consisting of 67 lbs./day of oil and 51.3

lbs./day of BOD.

Samples collected from the Blanchard River, another tributary of the Auglaize River, reveal two critical areas. The first dissolved oxygen sag occurs in the Blanchard River immediately below the City of Findlay, about mile point 52.5. Dissolved oxygen values below 4 mg/1 occurred about 38 per cent of the time.

Immediately below the Findlay sewage treatment plant, the water quality was severely degraded as indicated by the presence of only the pollution-tolerant sludgeworms, midge larvae, and air breathing snails. The stream bottom was silt and gravel with sludge banks along the edge. Sewage solids were observed floating in the water. The major oxygen consuming loads to the Blanchard originated from the following sources:

Waste Source	5 day BOD Discharged
Findlay Sewage Treatment Plant (Average value for October and November 1964)	953 lbs./day
Contris Packing	7 lbs./day
National Refinery	35 lbs./day
Total 5-day BOD	995 lbs./day

The wastes associated with these loads had a flow of 5 mgd and a dissolved oxygen concentration of 1.7 mg/l. The river flow below the Findlay Sewage Treatment Plant was almost entirely the effluent from the sewage treatment plant for three months, August, September, and October, 1964. The River recovers rapidly, and two miles below the sewage treatment plant the biota are typical of those found in a recovery zone.

Another oxygen sag occurs below Ottawa, Ohio. In addition to the municipal effluent from the city, the Buckeye Sugar Inc., which begins normal seasonal operation in October, discharged 2.69 mgd of waste with a BOD of 2,160 pounds per day. The high oxygen demand of these wastes caused the dissolved oxygen in the Blanchard River to fall to zero for a stretch of some 20 miles downstream to the point of confluence with the Auglaize River.

On the Blanchard River below Ottawa the median dissolved oxygen was 4.8 mg/l during June - September, zero in October and November. These conditions were the same at every sampling station to the confluence with the Auglaize River.

Below Ottawa, the median coliform densities increased from 290,000 organisms per 100 ml during the June - September period to 3,400,000 during the October - December period. The highest value recorded during this period was 114,000,000 coliform organisms per 100 ml.

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Biological surveys confirmed these findings of gross pollution. In October, conditions typical of a grossly polluted stream were observed. A strong odor of hydrogen sulfide perreated the area. The water was black, and the rocks in the stream were covered with black scum. Only the most tolerant forms of biological life were found throughout the length of the river to its mouth.

On the Auglaize, below the confluences with the Ottawa and Blanchard Rivers, another dissolved oxygen sag occurred. This is the most critical area of poor water quality in this river. During the summer, dissolved oxygen concentrations averaged 2 to 3 mg/l; during low flow in the fall season, it frequently dropped to below 1 mg/l. At mile point 25.6, which is directly below the confluence of the Blanchard River, the biochemical oxygen demand ranged from 4 to 40 mg/l while phenol concentrations averaged about 28 micrograms per liter. The maximum value of phenol was about 140 micrograms per liter.

During the summer, extensive algal growths were observed on the Auglaize River. Stream sampling indicated that, during the warm months, such compounds as phenols and organics were rapidly assimilated. During

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the winter months, the colder stream temperatures allow greater concentrations of these organic compounds to reach the Maumee River. Ammonia concentrations which averaged less than 2 mg/l during July and August 1964 in this area rose to a median concentration of 42 mg/l, and as high as 84 mg/l during October to December. These results reveal that the Auglaize is severely affected by the Ottawa and Blanchard Rivers during periods of low flow and low stream temperatures.

Give miles downstream the Auglaize deepens and the velocity decreases due to the pool formed by an old power dam at mile point 5.4. At mile point 14.8 bottom animals were limited to sludgeworms and midge larvae. Only the most tolerant bottom dwellers survive. In the lake behind the dam, phytoplankton productivity is high and oxygen supersaturation often occurs at the surface.

Immediately below the power dam, widely diversified fauna with many pollution-sensitive species were found, indicating that the water below the dam was well oxygenated. The abundance of Cladophora and the high plankton counts observed in the summer and fall are manifestations of the high nutrient content of the Auglaize River.

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About two miles below the old power dam, the backwaters of the Maumee River above Independence Dam begin to exert an effect on the Auglaize. Between mile point 3.5 and the confluence with the Maumee River the bottom animals are limited to sludgeworms and midge larvae. Photosynthetic oxygen production by the large algal population occasionally gave surface DO values of 20 mg/1.

Substantial winter fish mortalities of shad and other rough fish have been observed in the lower reaches of the Auglaize during the past four years. Since low dissolved oxygen was not a problem at that time of year the kills most likely resulted from the large ammonia concentrations mentioned previously.

The Little Auglaize River, Flatrock Creek, and Sugar Creek exert little, if any, effect on the main stem of the Auglaize.

Town Creek is a tributary to the Little Auglaize River and drains an area of 51.4 square miles. Samples from this stream, collected at a point below Van Wert, Ohio, revealed gross pollution during low flow. The dissolved oxygen dropped to zero in the summer. Samples collected were septic and foul smelling. Coliform densities exceeding 50,000,000 organisms per 100 ml were found.

Tiffin River

The overall water quality is good throughout the entire length of the Tiffin River. The dissolved oxygen exceeded 4 mg/l. The highest coliform densities, recorded near Stryker and Defiance, Ohio, rarely exceeded 5,000/100 ml. The highest fecal streptococcus values were obtained above Defiance and averaged 2,000/100 ml.

Upper Maumee River - Ft. Wayne, Indiana to Napoleon, Ohio

Directly below Ft. Wayne, Indiana, an oxygen sag occurs with values below 4 mg/l about 64 per cent of the time. BOD values were in the range of 4 - 15 mg/l. For the period October - December, 1964, phenol concentrations at this point had a median value of 5.2 micrograms per liter. During the winter period January to March, 1965, these concentrations ranged from 3 micrograms per liter to 137 micrograms per liter with a median value of 35 micrograms per liter. The median coliform count was 910,000 per 100 ml with a maximum of 24,000,000 per 100 ml during June to September, 1964. The median fecal streptococcus value was 1,300 per 100 ml during the same season.

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In the Fort Wayne area, biological conditions are seriously degraded. The stream bottom has heavy deposits of oily organic sludge and supports only a sparse population of pollution-tolerant sludgeworms and midge larvae.

The significant waste loads in the area originate from the following sources:

Ft. Wayne Sewage Treatment Plant	2200 lbs./day 5-day BOD
Parrot Packing House	890
Harvester Ditch	60
	3150 lbs./day 5-day BOD

Other significant wastes from these industries include:

Parrot Packing	136 lbs./day oil
Franke Plating	38 lbs./day cyanide

Between Fort Wayne and Antwerp, Ohio, the nutrient-rich waters develop tremendous phytoplankton population with counts in excess of 30,000 per ml. In this area algal photosynthesis is the most important factor affecting DO between April and December. Diurnal DO studies at Antwerp showed ranges of 3.8 to 8.2 mg/1 and 10.3 to 20.0 mg/1 on two 24-hour studies in July. The presence of relatively intolerant bottom dwelling animals in the Antwerp area indicates that prolonged

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periods of low DO do not occur here.

Thirty-six miles downstream near Antwerp, Ohio, Weatherhead Corporation discharges 33 lbs./day BOD and 240 lbs./day of oil.

At Defiance, Ohio, another oxygen sag occurs. This point is above the sewage treatment plant and is attributed to a large number of the unsewered and/or faulty sewered residences in Defiance discharging raw sewage into the Maumee River. The sewage collection system is faulty in that the sewage treatment plant is closed 30 to 60 days each year. As the River stage rises 5 feet above normal, water is backed up in the main lift station closing the main interceptor and sewage is bypassed directly to the River 2 miles above the plant. This is the area in which the oxygen sag occurs.

The DO was below 5 mg/l 20 per cent of the time during the period June to September, 1964, with a range of zero to 10 mg/l. During October to November, dissolved oxygen concentrations fell below 5 mg/l 11 per cent of the time with a range of 4.9 to 13 mg/l. Median coliform counts in this area were 54,000 per 100 ml with a maximum value of 830,000 per 100 ml. The highest fecal strep values in the upper Maumee River were obtained in this area during the summer of 1964.

A median value of 10,000 and a maximum value of 530,000 per 100 ml were found.

Phytoplankton counts were in excess of 100,000 per ml during the summer of 1964. During the same period, diurnal DO studies showed considerable vertical and diurnal variations. Values as high as 10 mg/l were often found at the surface while the bottom waters contained only 0.5 mg/l. Diurnal variations at the surface gave early morning concentrations of 8.0 mg/l and 25 mg/l in the afternoon. These low DO values explained the absences of any intolerant animals on the stream bottom.

The sewage treatment plant at Defiance provides only primary treatment facilities. An industrial and municipal waste survey by the State of Ohio indicated 1770 lbs./day BOD and 6750 lbs./day total solids in the final effluent. Phenol concentrations in the range of 14,000 - 22,--- micrograms per liter were recorded, which averaged slightly less than 100 lbs. of phenol discharged per day. Most of the industry in Defiance is sewered. However, primary treatment cannot assimilate the heavy loading of phenolic compounds from the Johns Manville Fiberglass Company.

A few hundred yards below the Defiance

Sewage Treatment Plant, wastes from the Central Foundry Division of General Motors Corporation are discharged. Visual inspection revealed large deposits of cinder and ash material in the River.

Below Independence Dam, the wide variety of intolerant bottom dwelling animals indicated that prolonged low DO conditions do not exist. The waters are rich in phytoplankton, and DO values well in excess of saturation occur during the day.

At Napoleon, Ohio, wastes discharged to the Maumee River originate from two major sources. The sewage treatment plant discharges an estimated 184 lbs. of BOD, and the Campbell Soup Company, 4,620 pounds of BOD, and 268 pounds of oil daily.

The river at Napoleon is 6 to 10 feet deep because of backwater of Providence Dam about 9 miles downstream. During summer months, dissolved oxygen drops to zero at times.

Cities situated on or near the Maumee River draw their raw water supply from the highly polluted waters of this stream. Taste and odor control is among the immediate and major problems in this area.

Taste and odor problems are prevalent throughout most of the year in the water supplies at Defiance and

Napoleon. At Defiance, during periods of low temperatures and ice cover, problems are encountered with phenolic compounds. The finished water imparts a medicinal taste and odor enhanced by chlorination. During the period of spring runoff, the water has an intense earthy or musty taste. During late spring in 1963, '64, and '65, there were periods of exceptionally severe taste and odor problems. The water during these periods was described variously as musty, moldy, earthy, fishy, and "rotten."

The taste and odor problems at Napoleon are similar to those in Defiance with the exception of additional interference from ammonia compounds from the Auglaize River. Campbell Soup Company has reported taste and odor problems of such severity that the plant had to shut down at times because of its inability to produce a taste and odor free water. Large concentrations of ammonia at the plant have created peak chlorine demands as high as 150 mg/l. The company reports that that quality of its raw water supply has steadily deteriorated since 1957.

Lower Maumee and Bay Area - Napoleon, Ohio - Toledo, Ohio

The waters in the lower Maumee River are severely polluted. Very high coliform densities were recorded in the lower River reaches, with median densities in excess of 150,000 organisms per 100 ml at mile point 0.3, and the highest values were greater than 1,500,000 organisms per 100 ml. The ratio of fecal coliform to fecal streptococcus was consistently above two, and as high as 150, indicating that the fecal bacteria are from human sources. The existence of human enteric pathogenic microorganisms was also revealed. Salmonella was detected 40 per cent of the times sampled, confirming the health hazard to persons exposed to these waters.

The dissolved oxygen was observed to be below 4 mg/1 at several locations in this portion of the stream.

Phenols are discharged into the Maumee River by Interlake Iron and Johns Manville Companies, located near Waterville. Phenols from Interlake Iron reach concentrations of 1,000 micrograms per liter.

Municipal wastes are discharged to the Maumee by the communities of Perrysburg and Waterville. The sewage treatment plant at Perrysburg has primary treatment and discharges on the average 320 pounds of BOD per day. Waterville has a secondary plant that discharges about 32 pounds of BOD per day.

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Effluent from the Toledo Sewage Treatment Plant is discharged to the river at mile point 0.6. This plant has secondary treatment and removes 85 - 90 percent of biochemical oxygen demand (BOD). Even so, the plant discharges on the average approximately 18,000 pounds of BOD every day into the river and Maumee Bay.

In addition to the effluent from the Toledo treatment plant, industrial wastes are being discharged throughout this lower reach. They include oily scum, mettalics, and toxic materials. Oils are being discharged to the Maumee by refineries. Standard, Gulf, and Sun Oil Companies are responsible. Interlake Iron and Libbey-Owens-Ford also contribute large amounts of oil each day.

With all these wastes being contributed to the Maumee River and Maumee Bay recreational use of these waters is severely damaged in the Toledo area, and swimming, water skiing, boating, and other water contact sports are hazardous to health.

Grand Rapid, Waterville, and Bowling Green obtain raw water from the Maumee River near Waterville, Ohio. The odors in the raw water at the Bowling Green Water Treatment Plant range through aromatic, earthy, septic, flowery, vegetative, grassy, fishy, and phenolic.

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Summer problems are with algae growth and decay, and resulting taste and odor. In recent winter periods, the ammonia content of the river water has reached 20 mg/l. Nitrates have reached values of 68 mg/l, and phosphates 2 mg/l. Synthetic detergents have also been a problem, causing foam four feet high on the recarbonation basin. Odors during the winter have been described as stale, rancid, and ammoniacal.

During low flow periods in the summer and early fall, problems originate from the great abundance of algal growths. These growths thrive on abnormally high concentrations of phosphate and nitrogen nutrients available in the water. During the late fall and winter seasons, phenolic and ammonia compounds from Ft. Wayne, Defiance, and Lima are able to survive oxidation for longer periods of time. Subsequently, these compounds reach raw water supplies all along the Maumee River.

Sediment is a problem in the navigational channel, which extends approximately seven miles upstream from the mouth of the river and must be continuously dredged. The suspended sediment is of the clayey type and stays in suspension for long periods of time.

The U. S. Geological Survey data for the water year of 1963 indicated that over 285,000 tons of sediment were carried by the Maumee River at Waterville.

Maumee River water severely affects Maumee Bay, which is the western tip of Lake Erie, in that it limits or affects the water uses of recreation, water supply, and esthetics.

Swimming, water skiing, boating and other water contact sports are affected by the health hazards due to the presence of human enteric pathogens such as Salmonella in the Maumee River.

Only one major Lake Erie swimming beach, Reno Beach, exists in the Toledo area. Reno Beach is officially closed because of bacterial contamination from the Maumee River.

The City of Toledo obtains its water supply from an intake located in Lake Erie approximately 9 miles east of the Maumee River. Toledo water is occasionally affected by Maumee River water. Its problems are not on the same scale as those cities whose source is exclusively the Maumee River. It is estimated by the City of Toledo that during some Spring runoffs, the Toledo intake will receive 70 to 90 per cent water from the Maumee. When this happens, hardness and alkalinity levels increase and occasional blooms of algae increase the taste and odor in its water. These blooms are fed by the large amount of nutrients being contributed to the Bay by the Maumee and also from the Toledo Sewage Treatment Plant.

Because Lake level fluctuations have been found to affect the Maumee River as far as 15 miles upstream, any form of pollution which enters the Maumee at its lower points also affects upstream portions of that section of river.

The City of Oregon obtains its water supply through an intake located east of Toledo's in Lake Erie.

The next chapter is on the Western Ohio Basin.

Description of Area

The Ohio tributaries to Western Lake Erie are the Portage, Sandusky, Huron, Vermilion, and Black Rivers. They drain an area of 4,100 square miles, with a population of 600,000. The principal cities are Lorain, Elyria, and Sandusky.

Hydrology

The rivers within this area are not hydraulically controlled to any great extent other than an occasional run-of-the-river dam. Low flows as measured at the U. S. Geological Survey gage nearest to the Lake are as follows: Portage 2.5 mgd; Sandusky, 21.5 mgd; Huron, 10.4 mgd; Vermilion, 7.2 mgd; Black, 1.6 mgd.

Economic Aspects

The economy of the area is diversified. Agriculture is predominant, with farm lands occupying 91 per cent of the basin. Industry is widespread throughout; heavy industry is concentrated in the Elyria-Lorain area on the Black River. Clay, glass, and stone products predominate in the western portion of the basin, while steel and transportation are important farther east.

Water Use

Inland surface waters supply 13 mgd to municipalities; wells supply another 5 mgd; and Lake Erie supplies 35 mgd.

Industrial

Industrial water use in the Western Ohio Basin is 227 mgd, and water used in power generation (exclusive of hydroelectric power) is 521 mgd. Of the total industrial water used in the basin, 7 mgd is used in each of the Portage and Sandusky River Basins and 220 mgd is used in the Huron to Black River Basin. With the exception of power generation, inland surface water and backwaters of Lake Erie supply 99 per cent of the demand.

Waterborne Commerce

Waterborne commerce in the Western Ohio area is served by the port facilities of Lorain at the mouth of the Black River, Huron at the mouth of the Huron River, and Sandusky at Sandusky Bay. These three ports account for 9 per cent of the tonnage moved through Lake Erie ports. No commercial navigation exists above the mouths of these rivers.

Recreation

The Sandusky Bay-Western Islands area is one of Ohio's principal recreational sites. Three state parks, a state beach, and a state reserve are located there.

Other bathing beaches and numerous boat marinas are located there and along the abutting shoreline of Lake Erie. There are no extensively developed

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recreational areas inland from the Lake.

Where the streams flow through communities, some municipal park facilities have been developed. Many historic sites are also found along the banks of these rivers.

Esthetics

The upstream reaches of these rivers flow through predominantly farm lands. As the streams flow toward the Lake through urban areas, the rivers become increasingly degraded so that their color has changed from blue to brown by the time they reach the Lake. Some of the color results from land erosion and industrial pollution.

In the navigation channel of the Black River, oil slicks on the water surface detract from the value of the adjacent properties.

(Figure III-1 follows.)

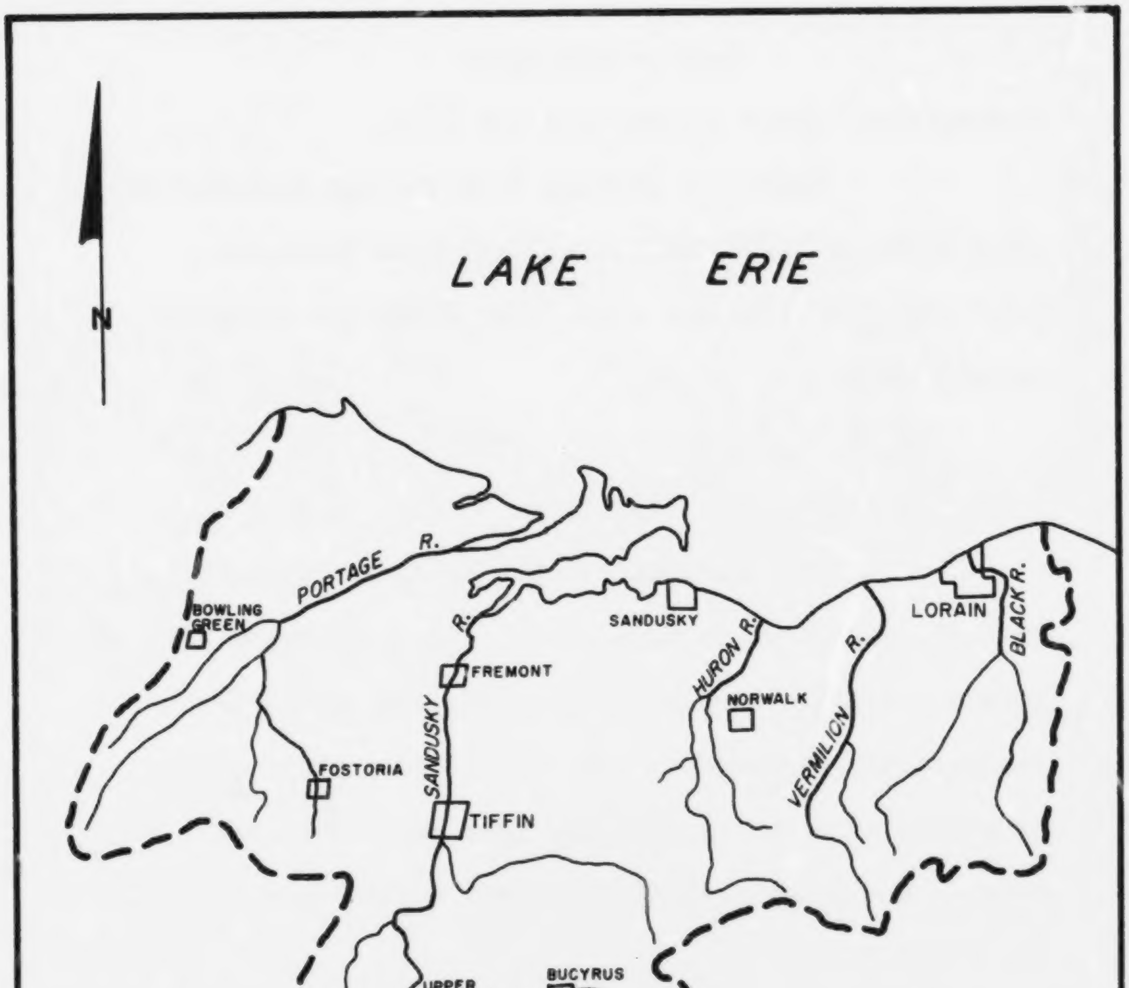
N
LAKE ERIE
PORTAGE R.
BOWLING GREEN
SANDUSKY R.
FREMONT
SANDUSKY
HURON R.
NORWALK
VERMILION R.
LORAIN
BLACK R.
FOSTORIA
TIFFIN
UPPER SANDUSKY
BUCYRUS
SCALE IN MILES
5 0 5 10 15 20
WESTERN OHIO BASIN

FIGURE III -1

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Sources of Wastes

There are 245,000 PE served by 41 secondary treatment plants and 222,000 PE served by 17 primary plants. 78,000 people are not served by any central treatment plant. Of the 27 industries located within the basin, five have inadequate treatment facilities according to the Ohio Department of Health.

DO - BOD Relationships

During periods of low flow the dissolved oxygen of the Sandusky River drops to less than 4.0 mg/l below Upper Sandusky, Tiffin, and Fremont. Forty per cent of the samples collected at the critical point below Upper Sandusky showed oxygen concentrations of less than 4.0 mg/l. On three occasions there was no measurable oxygen, and the BOD reached 39.0 mg/l. Intensive sampling programs below Tiffin and Fremont revealed that, during the low flow period and under normal loadings from the treatment plants, the DO concentrations approached 1.0 mg/l.

There are similar problems on the Black River from Oberlin to the lake-affected area in Lorain. The 1964 summer average of dissolved oxygen for this reach was 2 mg/l. Below Elyria, the average 5-day BOD was 20 mg/l.

Phenols

Along the heavy manufacturing area of the Black River, the phenols averaged 9.8 micrograms per liter during 1964 and ranged from 0.4 micrograms per liter to 65.9 micrograms per liter.

Land Runoff

Drainage and soil conditions in the flat areas are such that the fields are underlaid with drainage tile. Rural runoff to the Sandusky River carries with it sediment which amounts to over 100,000 tons per month during the spring. Nutrients present in the soil and from the application of approximately 180,000 tons of fertilizer annually to the Western Ohio Basin provide the algae and other aquatic growths with ample supplies of nitrogen and phosphorus to these rivers and have resulted in growths that completely blanket the Black River.

Microbiological

Sewage pollution as indicated by total coliform densities, is prevalent throughout most of the basin.

On the Portage River, at Port Clinton, median coliform density during the summer and fall of 1964 was 130,000 organisms per 100 ml. The fecal coliform density was 21,000 organisms per 100 ml.

The Sandusky River had a median coliform density of 190,000 organisms per 100 ml below Fremont for the months of October and November, 1964. In Sandusky Bay at the mouth of the river, the median coliform density was less than 1,000 organisms per 100 ml, with a high of 1,300 organisms per 100 ml.

Median coliform density in the Black River below the Elyria treatment plant was 300,000 organisms per 100 ml during the first three months of the year. During April and May, the median density was 140,000 organisms per 100 ml and the median fecal coliform density was 57,000 organisms per 100 ml.

Biology

Biological conditions in the Portage, Huron, and Vermilion Rivers are generally good except for the areas near the Lake which are degraded by siltation and local waste sources.

The Sandusky River below Upper Sandusky, Tiffin, and Fremont shows evidences of biological degradation. All pollution sensitive bottom-dwelling animals are absent below each area. Between Tiffin and Fremont, the nutrient-rich waters support dense growths of attached algae. Between Oberlin and the mouth of the Black River, biological conditions typical of a polluted stream are found.

Effects on the Lake

All the wastes emanating from the rivers in the western basin are diluted to the background concentrations of the Lake within a miles of the shoreline. However, the microbiological studies have shown that the bacterial pollution moves along the shore causing coliform densities to average 4,000 organisms per 100 ml east of Lorain. Average densities near Vermilion were 1,000 organisms per 100 ml.

ROCKY RIVER BASIN

Description of Area

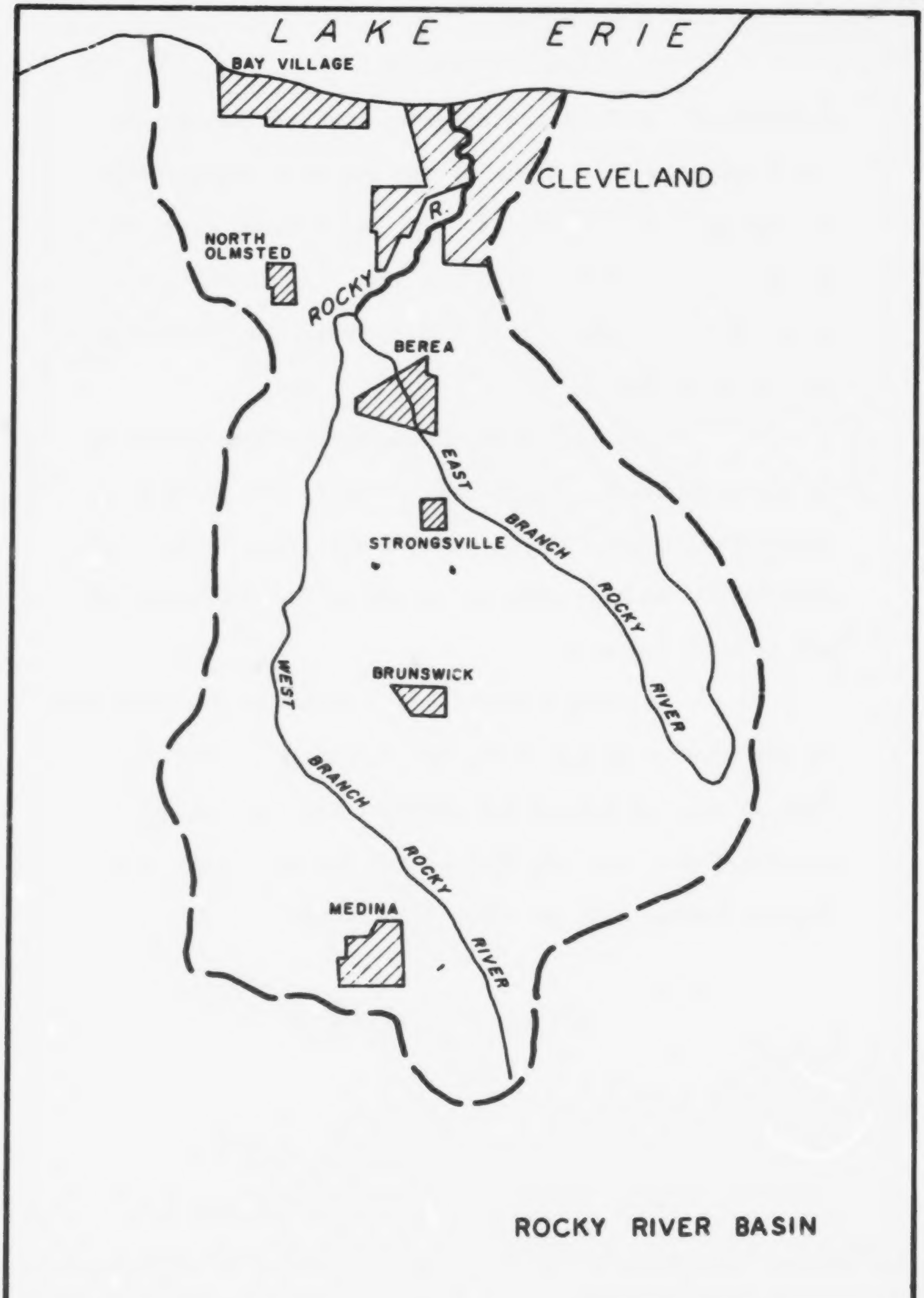
The Rocky River is located in northeastern Ohio and flows into the central basin of Lake Erie. It carries the drainage from farm lands, small cities, and the western part of metropolitan Cleveland.

The upper 35 miles of the river system is composed of two separate streams, the East Branch with its headwaters near Hinckley and the West Branch with its headwaters near Medina. The two streams meet at Berea and flow 12 miles to the Lake. Approximately 30 miles of this river system flow through the Cleveland Metropolitan Park.

The land area of the Rocky River basin is 44 per cent urban. Lands used directly for farming acitivities occupy 33 per cent of the area, while other rural lands such as woodland occupies the remaining 23 per cent of the area.

Although reservoirs located on both branches of the river regulate flow, the discharge of wastes from 15 sources supply the greatest part of the dry weather flow. The low flow at the United States Geological Survey gage at Berea is 3.9 mgd.

(Figure IV-1 follows.)


LAKE ERIE
BAY VILLAGE
CLEVELAND
R.
ROCKY
NORTH OLMSTED
BEREA
EAST BRANCH ROCKY RIVER
STRONGSVILLE
BRUNSWICK
WEST BRANCH ROCKY RIVER
MEDINA

ROCKY RIVER BASIN

FIGURE IV - 1

Stephen Megregian

Water Uses

Municipal and Industrial

Medina and Berea are the only municipalities using the Rocky River for water supplies. They draw an average of 1.7 mgd. No industries are known to withdraw water from the river.

Recreation

The Rocky River flows through Cleveland Metropolitan Park from near the Buyahoga County Line (on the East Branch) to Lake Erie where extensive recreational use is made of the River. Two marinas are located near its mouth. Hinckley and Lester Lakes afford good recreational sites which are regularly used.

Esthetics

Since much of the lower Rocky River flows through a much-used Metropolitan Park, the poor esthetic character of the stream reduces the park's value as a recreational area.

Debris and floating fecal solids have been observed at numerous locations. During the summer, the water is a deep green color due to algal blooms. The lower 15 miles of the stream often reek with a characteristic septic sewage odor, during periods of low flow.

Sources of Wastes

There are 129,000 people served by 20 secondary treatment plants and 34,000 PE served by two primary plants. Twelve thousand people are not served by central treatment plants. Three industries located within the basin have adequate treatment facilities, according to the Ohio Department of Health.

The average daily loads of this stream to the Lake are as follows: 7,300 lbs./day BOD; 3,400 lbs./day phosphate; 2,000 lbs./day nitrate-nitrogen; 110,000 lbs./day chlorides; 5 lbs./day phenols.

Effects of Wastes on Water Quality and Water Uses

Microbiological

Discharges from sewage treatment plants, storm water overflows, and ditches carrying septic tank drainage are causing high coliform densities in the river.

The studies on the main stem of the Rocky River above the lake-affected area showed sewage pollution which impairs the river use as a recreation area.

Stephen Megregian

Maximum coliform densities range from 55,000 to 1,000,000 per 100 ml.

Biology

The nutrients from the upstream sewage treatment plants fertilize the impounded areas of the stream so that large algal blooms develop during the summer months. The rooted aquatic weeds also increase. This plant life causes nuisance problems in the Metropolitan Park, as well as taste and odor problems in the Berea water supply. Slow-flowing and stagnant pools in the river provide ideal breeding areas for mosquitoes which create a serious nuisance condition in the park and surrounding areas.

Sewage Outfalls

The pollutional loads imposed on the river are manifested at its mouth by odors, floating sewage solids, and scum which are objectionable in a recreation area.

The organic load to the river has depleted the oxygen concentration below 4 mg/1 as much as 50 per cent of the time during the summer. Only local areas of pollution existed below waste inputs in the upper reaches of the river, the average BOD was greater than 4 mg/l throughout.

CUYAHOGA RIVER BASIN AND CLEVELAND LAKEFRONT

Area Description

The Cuyahoga River is located in northeastern Ohio where it drains the rural districts of Geauga and Portage Counties and the urban areas of Akron and Cleveland. Although the Cuyahoga basin represents only 3 per cent of the land area in the Lake Erie basin, 19 per cent of the entire basin's population live there.

Rising in the farm lands of Geauga County, the Cuyahoga River meanders for 103 miles through gorges and flat lands into the central basin of Lake Erie. Its network of tributaries drains an area of 813 square miles. Because of the many impoundments of its upstream waters, the river moves sluggishly until it reaches the Akron metropolitan area. Here, it becomes a rapidly flowing stream and continues this way to the navigation channel in Cleveland. In the navigation channel, the river again moves slowly toward Lake Erie. The fall of the upper Cuyahoga River is 9 feet per mile in a shallow channel cut through glacial drift. At Cuyahoga Falls, the river falls 220 feet in 1.5 miles through a sandstone gorge. The lower Cuyahoga River flows through a wide preglacial valley with a fall of 6 feet per mile.

Except for its upper reaches, must of the Cuyahoga Basin is highly urbanized. Cleveland and Akron with their expanding suburban communities occupy large sections of the basin. An estimated thirty-five per cent is forest land that lies in the supper Cuyahoga watershed and in the metropolitan parks of Cleveland and Akron. Idle lands occupy about fifteen per cent.

The lakefront in both the western and eastern portions is characterized by bluffs 50 - 70 feet in height and a narrow beach area. Within the Cleveland city limits, however, the bluffs decrease and become virtually nonexistent. Along this stretch there are wide beaches and many artificial works, the most prominent of which is the five-mile Federal Breakwater.

There are several small streams which drain the eastern section of Cleveland directly to Lake Erie. The largest of these are Euclid Creek, Doan Brook, and Dugway Brook.

Of the almost 31 miles of lake frontage in Cuyahoga County, 46% is occupied by housing, 16% by private (restricted) recreation, 15% by public recreation, 6% each by utilities and institutions, and 3% each by commerce and port facilities.

Flows in the Cuyahoga River are fairly high, due in a large measure to reservoirs in the upper watershed. Low flow at United States Geological Survey gage just upstream of Cleveland is 154 cfs.

(Figure V-1 follows.)

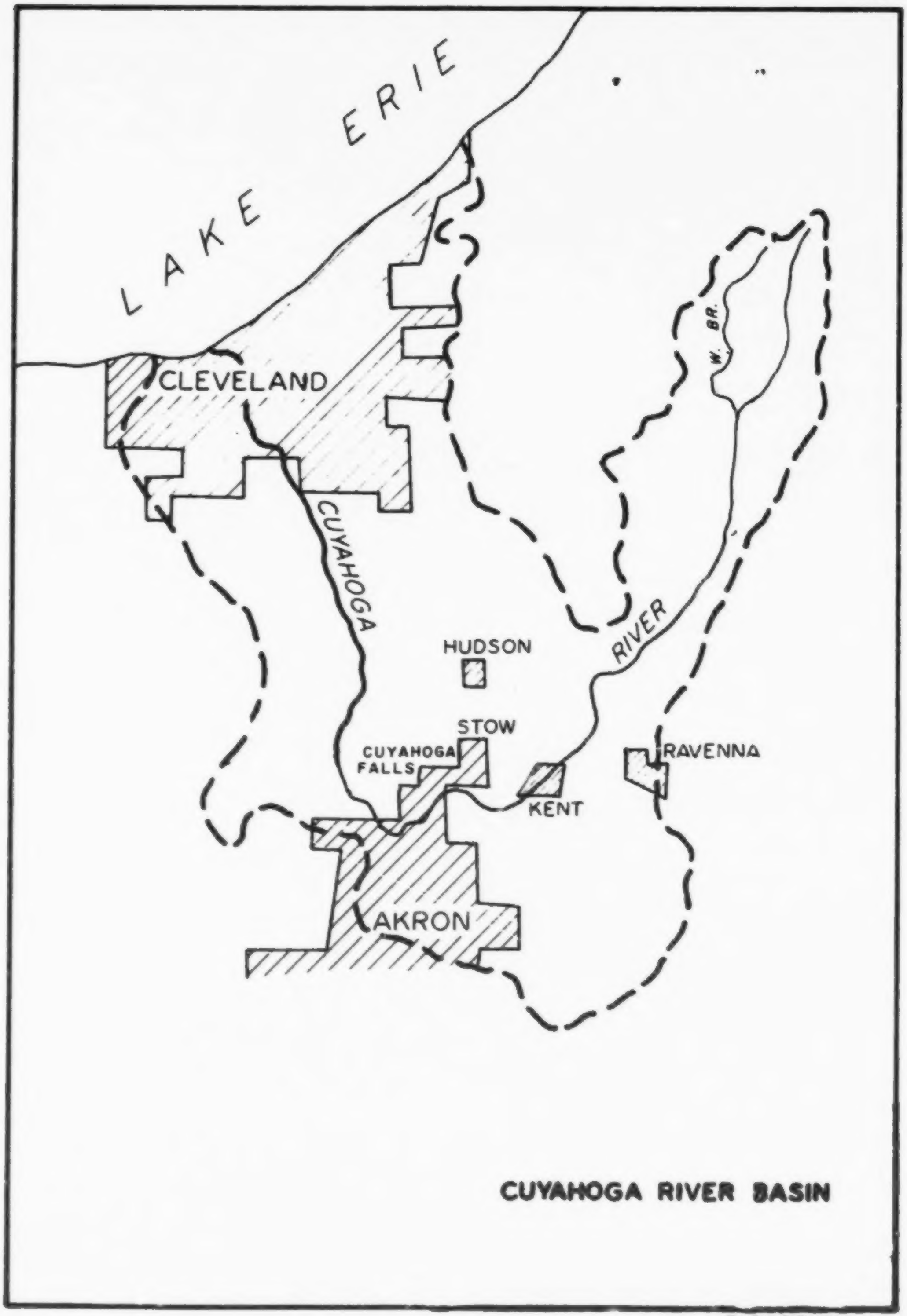

LAKE ERIE
CLEVELAND
CUYAHOGA
RIVER
W. BR.
HUDSON
STOW
CUYAHOGA FALLS
KENT
RAVENNA
AKRON
CUYAHOGA RIVER BASIN

FIGURE V - 1